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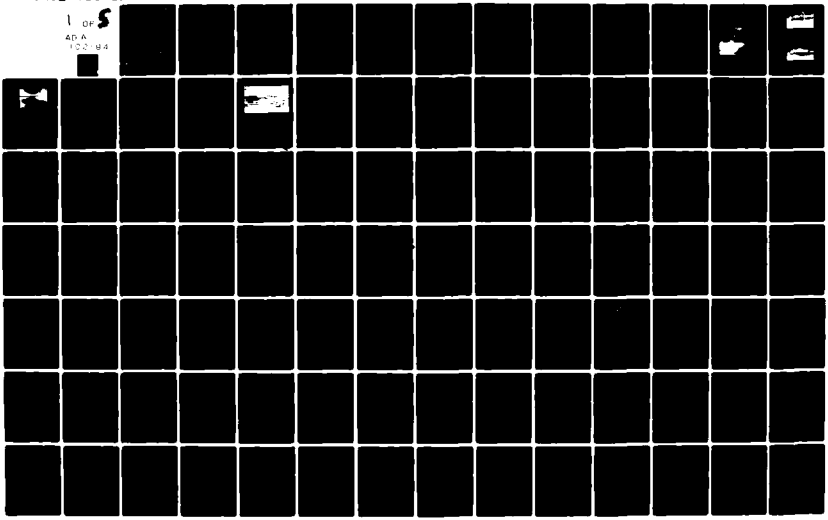

# STAGE 2 DOCUMENT
# FOR
# REFORMULATION PHASE I

## GENERAL DESIGN MEMORANDUM

# GENEVA-ON-THE-LAKE
# OHIO
# SMALL BOAT HARBOR

Richard /Aguglia John /Zorich
Steve /Golyski Joan /Pope
Steve /Tucker



U.S. ARMY CORPS OF ENGINEERS, BUFFALO DISTRICT
1776 NIAGARA STREET, BUFFALO, N.Y. 14207

JULY 1979
(REVISED APRIL 1980)

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# REPORT DOCUMENTATION PAGE

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The purpose of this Reformulation Phase 1 GDM is to reaffirm the viability of the 1969 plan in light of the changes that have occurred at the site since the project was authorized for construction, to develop a modified plan, or to recommend an entirely different plan (including "no action"), if a different plan more nearly satisfies the criteria of engineering, environmental, economic, social, financial, and political feasibility. Reformulation is necessary because of the probable adverse environmental impact to the existing wetland

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area in the location where the authorized project was to be constructed. Methods to minimize the environmental impacts will be investigated and will include relocating the harbor to avoid or reduce the amount of wetland disturbed, enhancement of the existing wetland area not affected by the harbor and creation of additional wetlands. If a viable plan is developed for the Geneva-on-the-Lake Small Boat Harbor project, an Environmental Impact Statement that addresses the existing physical condiditon at Geneva State Park and conforms with current policy and legislation, will be prepared. (~~see Section F~~ ~~Study Management, for the scheduled sub~~mission date of this Environmental Impact Staement) The Environmental Impact Staement will amoung other things assess the impacts of the recommended plan on the existing wetland area.

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**GENEVA-ON-THE-LAKE**
**SMALL BOAT HARBOR**
**STAGE 2 REPORT**
**FOR**
**REFORMULATION PHASE I GDM**

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ACKNOWLEDGMENTS

This Stage 2 Report was prepared through the efforts of many individuals on the Interdisciplinary Team within the Buffalo District of the Corps of Engineers and from other agencies and individuals involved with the Geneva-on-the-Lake Small-Boat Harbor project. The following are the Corps personnel who were most instrumental in conducting the investigation and preparing the text presented herein:

| | |
|---|---|
| Richard Aguglia | - Project Manager, Western Basin |
| John Zorich | - Chief, Western Basin |
| Steve Golyski | - Project Engineer, General Engineering |
| Joan Pope | - Geologist |
| Steve Tucker | - Economist |
| Alex Ratowski | - Economist |
| Melvin Hill | - Geologist |
| Michael Pryor | - Geologist |
| John Gerlach | - Geotechnical Engineer |
| Raymond Lewis | - Civil Engineer |
| John Lakatosh | - Biologist |
| Mary Jo Braun | - Social Scientist |
| Robert Klips | - Biologist |
| Jonathan Koszuta | - Survey Technician |
| Duane Syph | - Party Chief, Survey Branch |

Other agencies have contributed to this report through the preparation of supplemental reports and participation in agency workshops. The individuals involved are numerous and not easily identified. Therefore, recognition is provided by the names of their employing agencies as follows:

U. S. Fish and Wildlife Service, Columbus, OH, Field Office
Ohio Department of Natural Resources

The report itself was produced through the efforts of many other Corps personnel, including the following who contributed significantly to its preparation:

| | |
|---|---|
| Roman Bartz | - Chief, Drafting Section |
| William Sweet | - Drafting Section |
| Christine Kosinski | - Drafting Section |
| John Acres | - Drafting Section |
| Mary Hamilton | - Drafting Section |
| Freda Soper | - Chief, Word Processing Center |
| Linda Cottrell | - Word Processing Center |
| Mary Ann Schultz | - Word Processing Center |
| Wilbert Binga | - Chief, Reproduction Section |

The Buffalo District Engineer during the final phase of the Stage 2 preparation was Colonel George P. Johnson and the Chief of the Engineering Division was Donald M. Liddell.

Finally, the efforts of other individuals who participated in the study and report preparation but whose names have not been mentioned above, are gratefully acknowledged.

# SECTION A
# INTRODUCTION

The purpose of this section is to introduce the reader to the Geneva-on-the-Lake Small-Boat Harbor study and to explain the content and organization of this report. The section presents information on the geographical setting of the study area, the study authority, the purpose of the study, the scope of the study, study participants and coordination, the organization of the report and information on other ongoing Corps of Engineers investigations in the area.

## GEOGRAPHICAL SETTING

Geneva-on-the-Lake, as shown on Plate 1 in Appendix I, is located on the south shore of Lake Erie about 17 miles east of Fairport Harbor, OH, and 12 miles west of Ashtabula Harbor, OH, both of which are Federally improved deep-draft harbors. Geneva-on-the-Lake was identified as a promising location for a small-boat harbor and harbor-of-refuge because of its strategic location within the boundaries of a State recreational park which is presently still being developed by the State of Ohio, its strategic location with respect to existing harbors, its proximity to productive fishing grounds and the appreciable boating demand within the tributary area.

Plate 2 is a map showing the existing and proposed recreational development at Geneva State Park. When completed, the park will encompass approximately 466 acres and will provide opportunities for camping, swimming, boating, fishing, picnicking, and hiking. Facilities completed to date include a bathhouse pavilion, picnic tables, cooking grills, lavatory facilities, a pedestrian foot bridge crossing Cowles Creek, and 12 housekeeping cabins. Pictures of some of these facilities are shown in Figures 1 to 4. The park is easily accessible from Interstate 90 and State Route 534 through the city of Geneva and the village of Geneva-on-the-Lake.

## STUDY AUTHORITY

### Congressional Authority

Section 6 of Public Law 79-14, approved 2 March 1945, authorized and directed the Secretary of War to cause preliminary examinations and surveys to be made on the south shore of Lake Erie with a view to the establishment of harbors and harbors-of-refuge for light draft commercial and fishing vessels and for recreational craft. In partial compliance with this authority, a comprehensive preliminary examination report, favorable to 33 locations on the coast of Lake Erie, was submitted on 19 July 1946. Preparation of survey reports thereon was authorized by the Chief of Engineers on 20 December 1946.

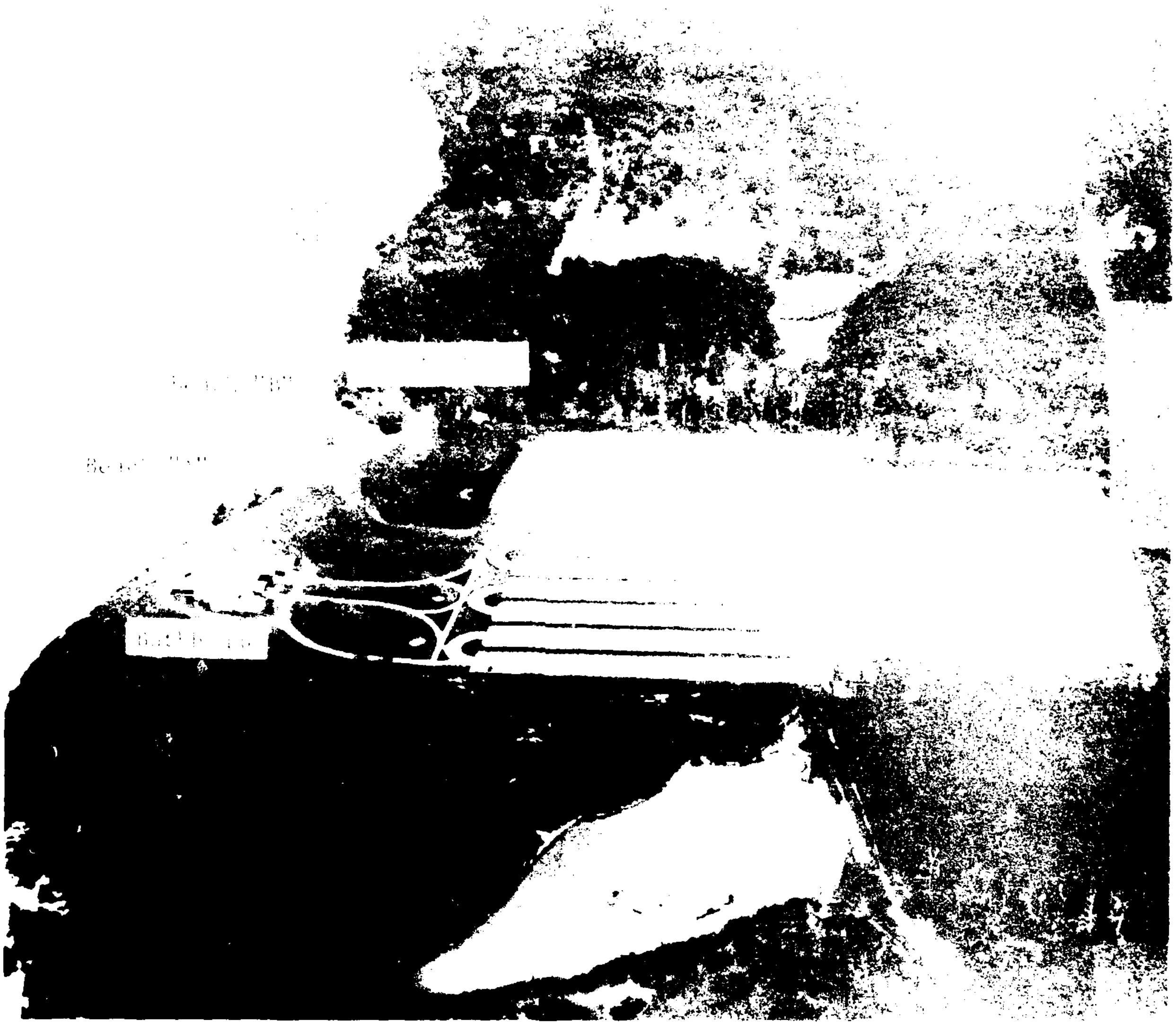


Figure 1: Aerial ...
State Park (photo ...

Figure 2: Picnic area and change booths near Beach "B" (photo taken 11/77).

Figure 3: Bathhouse Pavilion (photo taken 11/77).

Figure 4: Pedestrian foot bridge crossing Cowles Creek (photo taken 11/77).

An Interim Report, completed in February 1969, examined the feasibility of constructing a small-boat harbor at Geneva-on-the-Lake, OH, which was being developed by the State of Ohio as a State Park. The Geneva-on-the-Lake site was not originally included in the preliminary examination report completed in 1946. It is a substitute site for Arcola Creek, as suggested by the State of Ohio and approved by the Division Engineer, North Central Division. The site is approximately two miles east of Arcola Creek.

The Interim Report gave a favorable recommendation for the harbor project and the results were published in House Document No. 91-402. The project was subsequently authorized for construction under Section 201 of the 1965 Flood Control Act (Public Law 89-298) by the House and Senate Committees on Public Works by Resolutions dated 15 December 1970 and 17 December 1970, respectively. Funds to initiate the Advanced Engineering and Design of the project were appropriated in Fiscal Year 1978.

## Description of Authorized Project

The project, as authorized, will provide a small-boat harbor and harbor-of-refuge and recreational fishing facilities as an integral part of the State Park at Geneva-on-the-Lake. The plan recommended in House Document No. 91-402, and shown on Plate 3 in Appendix I, would provide for:

(1) Breakwaters in Lake Erie aggregating about 1,400 feet in length, with a riprapped spending beach between the entrance channel and the inner end of the west breakwater;

(2) An entrance channel about 1,000 feet long and varying from 180 to 100 feet in width, eight feet deep for the outer 500 feet and six feet for the inner, extending from the eight-foot depth in the lake into the dock channel;

(3) A dock channel, 100 feet wide, 1,500 feet in length, and six feet deep, widened to 200 feet at the junction with the entrance channel; and

(4) Development of recreational facilities.

## Items of Local Cooperation in Authorizing Document

Authorization for these improvements was made subject to the requirement that local interests agree to:

(1) Provide without cost to the United States all lands, easements, and rights-of-way required for construction and subsequent

maintenance of the project and for aids to navigation upon the request of the Chief of Engineers, including suitable areas determined by the Chief of Engineers to be required in the general public interest for initial and subsequent disposal of spoil, and also necessary retaining dikes, bulkheads, and embankments therefor or the cost of such retaining works;

(2) Hold and save the United States free from damages due to the construction and subsequent maintenance of the improvements;

(3) Provide and maintain necessary access roads, mooring facilities, and parking and service areas, including a launching ramp, all essential sanitary facilities, and an adequate public landing or wharf, with provisions for the sale of motor fuel, lubricants, and potable water, available to all on equal terms;

(4) Provide and maintain depths in the service channels to principal docks and berthing areas commensurate with those provided in the Federal project;

(5) Accomplish without cost to the United States such relocations or alterations of utilities as necessary for project purposes;

(6) Establish rules to control the use, growth, and development of the harbor and related facilities, with the understanding that public facilities will be open to all on equal terms;

(7) Reserve spaces within the harbor adequate for the accommodation of transient craft;

(8) Establish regulations prohibiting discharge of pollutants into the waters of the harbor area by users thereof, which regulations shall be in accordance with applicable laws or regulations of Federal, State, and local authorities responsible for pollution prevention and control;

(9) Contribute in cash 50 percent of that portion of the first cost of Federal construction allocated to recreational navigation, exclusive of aids to navigation, a contribution presently estimated at $576,000[1/] on December 1968 price levels, to be paid in a lump sum prior to initiation of construction, or in installments over the construction period at a rate proportionate to the proposed or scheduled expenditure of Federal funds, as required by the Chief of Engineers, the final apportionment of cost to be made after actual costs have been determined;

---

[1/] $1,575,000 on October 1978 price levels.

(10) Contribute in cash one-half of the cost of modifications necessary to provide for recreational fishing from the breakwaters, an amount currently estimated at $29,000[2] on December 1968 price levels; and

(11) Bear all costs of maintenance, operation, and replacement of these modifications for recreational fishing, an amount currently estimated at $1,900 on December 1968[3] price levels on an average annual basis;

And provided further, that the improvement for navigation may be undertaken independently of providing public recreational facilities for breakwater fishing whenever the required local cooperation for navigation has been furnished.

Prior to the submission of the 1969 Interim Report on Geneva-on-the-Lake to Congress, the Chief of Engineers recommended that maintenance of the general navigation features be an item of local cooperation. This item of local cooperation was later eliminated by the authorizing Congressional Resolutions of December 1970 to conform to Section 103 of the River and Harbor Act of 1970 (PL 91-611) whereby the costs of operation and maintenance of the general navigation features are to be borne by the United States and thus will not be an item of local cooperation.

The local cooperator for the project is the Ohio Department of Natural Resources (ODNR). Recent correspondence with ODNR indicating their willingness to provide the local cooperation is included as Exhibits E-1, E-2, and E-3 in Appendix E, "Pertinent Correspondence."

PURPOSE OF REFORMULATION PHASE I GDM AND THE STAGE 2 REPORT

Reformulation Phase I GDM

Several legislative and physical changes, having a direct influence on the feasibility of constructing the authorized project, have occurred since the 1969 Interim Report was submitted to Congress and subsequently authorized for construction. These changes, depicted on Plate 4 in Appendix I, and developed in greater detail in Section B of the Main Report include: the construction of a parking lot at the location originally proposed for the mooring area, and the expansion of an existing wetland area within the location originally proposed for the launching area and turning basin with increased emphasis through legislative changes on preservation of this wetland area for environmental reasons. Figure 5 is an aerial view of the proposed harbor area with the authorized project superimposed upon it.

[2] $75,000 on October 1978 price levels
[3] $ 4,500 on October 1978 price levels

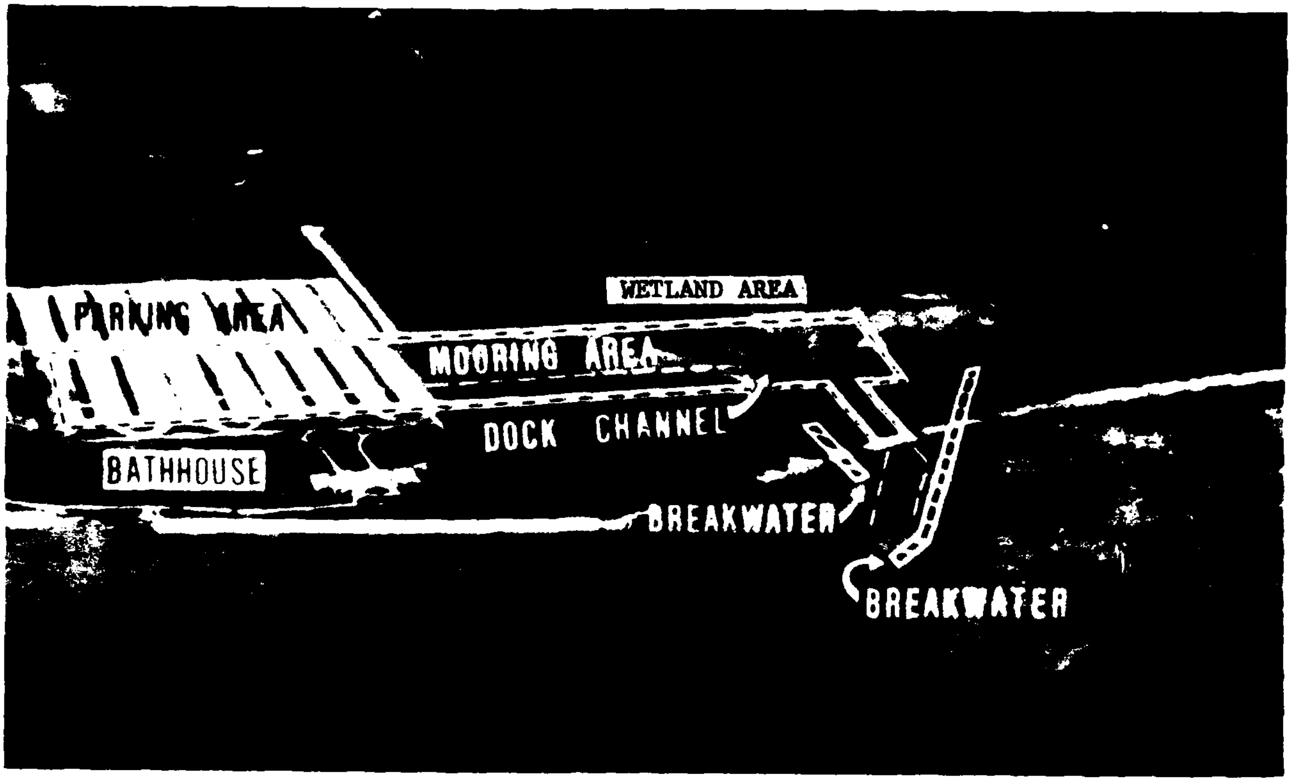



Figure 5: Aerial view of Geneva State Park with the authorized small boat harbor superimposed upon it (photo taken 8/76).

The purpose of this Reformulation Phase I GDM is to reaffirm the viability of the 1969 plan in light of the changes that have occurred at the site since the project was authorized for construction, to develop a modified plan, or to recommend an entirely different plan (including "no action"), if a different plan more nearly satisfies the criteria of engineering, environmental, economic, social, financial, and political feasibility. Reformulation is necessary because of the probable adverse environmental impact to the existing wetland area in the location where the authorized project was to be constructed. Methods to minimize the environmental impacts will be investigated and will include relocating the harbor to avoid or reduce the amount of wetland area disturbed, enhancement of the existing wetland area not affected by the harbor and creation of additional wetlands. If a viable plan is developed for the Geneva-on-the-Lake Small-Boat Harbor project, an Environmental Impact Statement, that addresses the existing physical condition at Geneva State Park and conforms with current policy and legislation, will be prepared (See Section F, "Study Management," for the scheduled submission date of this Environmental Impact Statement). The Environmental Impact Statement will, among other things, assess the impacts of the recommended plan on the existing wetland area.

Revisions to the authorized plan will also be investigated to reduce the impact of the authorized project on an existing parking lot that was constructed by the State of Ohio to serve the beach at Geneva State Park after the 1969 Interim Report was submitted to Congress and subsequently authorized for construction. At the time the parking lot was constructed it was felt that the mooring area could be reoriented and "flipped" 180° in relation to the entrance channel. If this course of action were to be taken, however, the mooring area would encroach on the existing wetland area. As discussed above and developed in greater detail in Section B of the Main Report, this encroachment poses severe environmental concerns that were not anticipated when this parking lot was constructed. The reformulation study will therefore investigate alternatives which minimize the impact of the harbor on the parking lot while at the same time minimizing the impact of the harbor on the environment.

Correspondence regarding the need for a Reformulation Phase I GDM and approval to conduct a reformulation study is provided as Exhibits B-12 and B-13 of Appendix B in the approved Plan of Study for the Geneva-on-the-Lake, Ohio Small-Boat Harbor Study, April 1978 (Revised August 1978).

<u>Stage 2 Report</u>

The purpose of this Stage 2 Report is to present the results of the Stage 2 planning effort conducted to identify and analyze a wide

range of alternative measures to provide a small-boat harbor and harbor-of-refuge and recreational fishing facilities as an integral part of the State Park at Geneva-on-the-Lake. The alternatives were developed in sufficient detail to provide initial choices as to the range of viable resource management options available in the study area. They did not concentrate on detailed engineering or design considerations. However the alternatives were developed in sufficient detail to: (1) identify all major components of each alternative; (2) to estimate the first cost of construction and the annual operation and maintenance cost associated with each alternative; (3) to estimate the benefits associated with each alternative; and (4) to assess the impacts of each alternative on the existing environment based on the environmental data that was available.

At the conclusion of this Stage 2 Report a recommendation will be made as to whether or not to continue the study into Stage 3 planning (Development of Detailed Plans). In addition, if the recommendation is to proceed into Stage 3 planning, the most feasible alternative plans that should be investigated will be identified. These recommended alternative plans would then be developed in sufficient detail so that a rational choice could be made among them and, if appropriate, an alternative could be recommended for implementation.

## SCOPE OF THE STUDY

### General

As previously discussed, the Geneva-on-the-Lake site for a small-boat harbor was not originally included in the preliminary examination report completed in 1946. It is a substitute site for Arcola Creek, as suggested by the State of Ohio and approved by the Division Engineer, North Central Division. The site is approximately two miles east of Arcola Creek.

At the initial workshop meeting for this study on 15 December 1977, the Ohio Department of Natural Resources, the local sponsor for the project, stated that they were opposed to acquiring any additional land outside the boundaries of the State Park for a small-boat harbor. They also stated that due to existing and future park development, the only area available for a small-boat harbor was between Cowles Creek and the wetland area to the west of the existing parking lot (see Plate 2 in Appendix I which is a map showing the existing and proposed recreational development at Geneva State Park). Therefore, with the exception of a posible mitigation site as discussed below, the scope of this study was limited to the area between Cowles Creek and the wetland area at Geneva State Park. (Minutes of this workshop meeting are included as Exhibit F-1 in Appendix F, "Public Involvement").

## Field Investigations

Several field investigations, as discussed below, were conducted for this Stage 2 report. These investigations included: (1) a seismic survey to establish the location of top of rock in the study area; (2) a bathymetric survey to establish offshore conditions; and (3) a biological data collection program to provide sufficient biological data to assess the effects of the alternatives on the existing environment.

(1) Seismic Survey - The final location, size, and shape of a small-boat harbor at Geneva State Park will be highly dependent on the location of top of rock which is near the earth's surface in much of the area. The location of the authorized project was chosen to minimize the amount of rock excavation and consequently minimize the construction cost of the project. Rock probings indicated that the authorized project could be constructed with little or no rock excavation. Any alternative location to the authorized project location must minimize the amount of rock excavation because of associated high construction costs that would jeopardize the economic feasibility of a small-boat harbor at Geneva State Park. For this reason, the Corps undertook a seismic survey of the study area through a contract with Warren George Inc. of Jersey City, NJ. The results of this seismic survey are presented in Appendix A, "Geology, Soils, and Construction Materials."

(2) Bathymetric Survey - A bathymetric survey was undertaken by Buffalo District personnel in the Summer of 1977 and supplemented by additional survey work completed in the Fall of 1978. The purpose of this survey was to establish the offshore bottom contours in the study area. This information was required for the preliminary wave refraction and diffraction studies used to design the breakwaters for each alternative plan and to allow an estimate to be made of the quantity of dredging that would be required for each alternative. Results of this bathymetric survey are presented in Appendix A.

(3) Environmental Studies - Due to the lack of current biological information in the study area, the U.S. Fish and Wildlife Service (Columbus, Ohio, Field Office) was requested to conduct a four season survey on the Cowles Creek/wetland area/Lake Erie complex for the Buffalo District through an interagency support agreement. The objectives of this study are to: (1) identify species composition, density and distributon of the flora and fauna in the area; (2) identify and evaluate the habitat important for major taxonomic groups; and (3) provide data and information that will allow assessment of the impacts of any structural plans that may be considered. This interagency support agreement was later modified to include biological data collection for Wheeler Creek at the west end

of Geneva State Park. This area was identified by ODNR as a possible site for mitigating any loss of existing wetland area due to the construction of the small-boat harbor.

The data collection program was started in the Fall of 1978 and will continue into the Fall of 1979. The results of the Fall 1978 and the Spring 1979 surveys are presented in Appendix G, "Reports of Others" as Exhibit G-1. This limited biological information was used to assess the effects of the alternatives investigated for this report on the existing environment at Geneva State Park.

Office Investigations

Several office studies, as discussed below, were conducted by Buffalo District personnel for this Stage 2 report. These studies include: (1) a regional boating demand analysis to establish recreational boating needs in the area; (2) a regional fishing demand analysis to establish recreational fishing needs in the area; (3) a preliminary wave refraction and diffraction analysis to establish deep-water wave conditions used for design of the breakwaters for each alternative; and (4) a littoral study to establish the predominant littoral currents in the study area.

(1) Regional Boating Demand Analysis - Various current and projected socioeconomic variables such as income level, household size, leisure time and population were assembled and analyzed to forecast existing and future demand for permanent boat moorings and trailered boat launching facilities in the Ashtabula County area. This demand forecast was then used to develop the anticipated fleet mix (size and type of boat) that could be expected to use a small-boat harbor at Geneva-on-the-Lake. The anticipated fleet mix was then used to estimate benefits that would accrue due to construction of a small-boat harbor and to determine the size of the required mooring area and new harbor facilities such as launching ramps, sanitary facilities, etc., required for optimum use of the small-boat harbor. The results of this regional boating demand analysis are presented in Appendix D, "Economic Evaluation."

(2) Regional Fishing Demand Analysis - The same current and projected socioeconomic variables analyzed for the regional boating demand analysis were also used to estimate the demand for fishing activity days in the Ashtabula County area. A monetary value for each activity day will be developed by the U.S. Fish and Wildlife Service, in order to estimate the benefits that would result from providing breakwater fishing facilities as a part of the small-boat harbor at Geneva State Park. The results of the regional fishing demand analysis are presented in Appendix D, "Economic Evaluation."

(3) Preliminary Wave Refraction and Diffraction Analysis - The wave refraction and diffraction analysis developed for the Geneva State Park Shoreline Erosion Demonstration Project (discussed later in this section) was modified to provide a preliminary analysis for the shoreward propogation of the design deep-water waves at Geneva State Park for this Stage 2 report. This information was required in order to design the breakwaters for each alternative investigated. The results of this analysis are presented in Appendix B, "Design and Coastal Processes." As indicated in Appendix B if a recommendation is made to continue the study into Stage 3, a more detailed analysis will be required.

(4) Littoral Study - A littoral study was conducted to determine the quantity of sediment annually transported in the nearshore system at Geneva State Park. This information was required in order to estimate the annual maintenance dredging requirements for a small-boat harbor and to assess the erosive effects of the harbor structures on the adjacent shoreline areas. The results of this study are presented in Appendix B.

## STUDY PARTICIPANTS AND COORDINATION

### Public Involvement

On 22 March 1978, a public meeting was held in Geneva, OH, to solicit information from the general public and insure a fully coordinated Plan of Study. Participants were given the opportunity to express their views on the project and to provide a sketch of the harbor they feel will best suit their needs. Statements made at this meeting indicate strong public support for construction of this project at the earliest possible time. A copy of the public meeting announcement, along with the information packet on the Geneva-on-the-Lake project and the public responses received, are included in Appendix C of the Plan of Study for this project.

The completed Plan of Study for this project was distributed to the political leaders in the area and to various local, State, and Federal agencies for their review and comment. Loan copies of the POS were also supplied to local libraries for review by the general public and various civic groups. In addition, until the supply was exhausted, personal copies of the report were made available to study participants free of charge.

Following approval of this Stage 2 report a public meeting will be held in Geneva, OH. The purpose of this meeting will be to present the results of the Stage 2 investigation and to solicit public comment. All comments made at this meeting will be given equal consideration and those that warrant further study will be investigated during Stage 3 planning.

## Coordination with the Ohio Department of Natural Resources

Several workshop meetings have been held with the Ohio Department of Natural Resources during the course of this study. At the initial workshop meeting on 15 December 1977, the Ohio Department of Natural Resources (ODNR), the local sponsor for this project, voiced its opposition to elimination of any parking area due to construction of the authorized small-boat harbor and requested that the harbor be moved westward of its original location to prevent reduction in the size of the parking area. ODNR also stated that they were opposed to acquiring any additional land outside the boundaries of the State Park for a small-boat harbor. Minutes of this workshop meeting are included as Exhibit F-1 in Appendix F, "Public Involvement."

The second workshop meeting was held on 18 January 1979. The purpose of this workshop meeting was to review the results of the studies conducted to date for the small-boat harbor study and to come to a decision regarding which of eight preliminary harbor layouts prepared by the Buffalo District were acceptable to ODNR. As a result of this workshop meeting, and as developed in greater detail in Section C of the Main Report, four preliminary harbor layouts were eliminated from further consideration. Minutes of this workshop meeting are included as Exhibit F-2 in Appendix F.

A third workshop meeting with ODNR and USF&WLS was held on 29 May 1979 at the Park. The purposes of this workshop were to discuss the preliminary layouts, designs, and costs that Buffalo District had prepared for the four alternative plans selected for further study with the principal agencies involved in the study, and to obtain a concensus on the plan(s) to be carried into Stage 3 planning. ODNR stated that they would need additional time to study the construction and operating costs of each of the four alternatives before stating a preference. Therefore, no decision was made on the plans to be considered in Stage 3 at this workshop. See Exhibit F-3 of Appendix F for the summary minutes.

## Coordination with the U.S. Fish and Wildlife Service

As stated above, the authorized project is located within the boundaries of an existing wetland area and its modification or elimination poses severe environmental concerns. At the initial workshop meeting for this study on 15 December 1977, the USF&WL Service stated that agency would oppose any project that destroys the wetland area but that they would consider mitigative measures. They reemphasized their concern over destruction of the existing wetland area in their preliminary "Planning Aid Letter" and final "Planning Aid Letter" dated 7 March 1978 and 15 May 1978, respectively and recommended that alternative harbor sites be investigated. Copies of the preliminary

and final "Planning Aid Letter" are included in the Plan of Study for this project.

Due to their concern over destruction of the existing wetland area the USF&WL Service has been kept informed on the progress and results of this study through correspondence and verbal communications. They were provided with the eight preliminary harbor layouts prepared by the Buffalo District for the 18 January 1979 workshop meeting with ODNR and their comments and suggestions were requested. Where possible their suggestions were incorporated into the four preliminary harbor layouts selected for further study. In addition, the USF&WL Service attended the 29 May 1979 agency workshop at which they indicated: a preference for a marina location outside the wetlands (Cowles Creek area); opposition to the plan where the marina would be located in the wetlands; and a willingness to consider further two plans that would partially encroach into the wetlands (see Exhibit F-3 of Appendix F). Followup letters from the F&WLS (Exhibits E-8, and E-9, of Appendix E) modified their position to exclude further study of one of the plans that would partially encroach into the wetlands.

## Model Study Coordination

A model study of the recommended small-boat harbor alternative at Geneva State Park will be necessary in order to provide a safe entrance and to determine the most economical breakwater configuration which will provide adequate protection for small craft in the harbor. The model is also needed to determine the resultant wave heights in the harbor mooring area since the complex wave actions cannot be accurately determined mathematically. The model will also provide qualitative information on the effects the breakwaters will have on the littoral processes.

The Corps of Engineers Waterways Experiment Station (WES) has been requested to perform the model study and has provided the Buffalo District with an estimate of the cost and schedule to conduct this study. Approval to conduct this study was provided by the Office of the Chief of Engineers by letter dated 7 May 1979. Correspondence relating to this model study is included in Appendix E, "Pertinent Correspondence," as Exhibits E-4 and E-5.

## Cultural Resource Coordination

By letter dated 23 October 1978 Buffalo District requested information on the cultural resources in the study area. This letter was sent to to the Ohio Historic Preservation Office, the Regional Heritage Conservation and Recreation Service, Ann Arbor, MI, and the Advisory Council for Historic Preservation, Washington, DC. By letter dated 3 November 1978 (Exhibit E-6 in Appendix E), the Ohio

Historic Preservation Office stated that there was no known archaeological properties recorded in the study area but recommended that an archaeological survey be completed before any land alteration is undertaken. The Regional Heritage Conservation and Recreation Service replied by telephone call on 14 November 1978 (Exhibit E-7) and stated that no information on cultural resources in the study area was available. No reply was received from the Advisory Council for Historic Preservation. If the recommendation of this Stage 2 report is to continue into Stage 3 planning, a Cultural Resources Reconnaissance will be conducted to insure that all historical sites are identified prior to plan implementation.

### Coordination of the Stage 2 Documentation

The Stage 2 Report (July 1979) for this study was coordinated with and reviewed by North Central Division and Office, Chief of Engineers. Based on this coordination and review, a limited number of revisions have been incorporated into the text presented herein. Pages that have been revised are identified by the bottom corner notation "Rev April 1980," as below.

## THE REPORT

The overall organization of this report consists of a Main Report, a series of Technical Appendices (Appendices A through D), a Pertinent Correspondence Appendix (Appendix E), a Public Involvement Appendix (Appendix F), Reports of Others (Appendix G), a Study Management Appendix (Appendix H), and a Plate Appendix (Appendix I). The Main Report is a nontechnical summary of the results of this Stage 2 study, understandable to the layman, and includes information on plan formulation and selection procedures; division of project responsibilities between Federal and non-Federal interests; and the conclusions and recommendations of the study. The Technical Appendices provide additional detailed information on the design, costs and benefits of the alternatives studied. The Pertinent Correspondence Appendix includes copies of pertinent correspondence with organizations and individuals, significant in the development of this Stage 2 study. The Public Involvement Appendix includes minutes of the workshop meetings conducted during the course of this study. Reports of Others (Appendix G) includes the U. S. Fish and Wildlife Service's report on the results of the biological data collection program completed to date. The Study Management Appendix contains a revised "Study Flow Network" which outlines the future major study activities for this Phase I GDM study and an updated "Proposed Schedule of Major Activities" which outlines the future major activities prior to construction of a small-boat harbor at Geneva State Park. The Plate Appendix includes all the plates developed for the Main Report for easy reference.

## OTHER ONGOING CORPS OF ENGINEERS INVESTIGATIONS IN THE AREA

There are presently two other ongoing Corps investigations within Geneva State Park: (1) a Shoreline Erosion Demonstration Project;

and (2) a study of Shoreline Erosion of Lake Erie at Geneva State Park, Ohio.

The purpose of the Shoreline Erosion Demonstration Project (authorized in Section 54 of the Water Resources Development Act of 1974 (PL 93-251)) is to develop, demonstrate, and disseminate information about low-cost means to prevent and control shoreline erosion.

The Demonstration Project at Geneva State Park consists of the construction of three different types of low-cost offshore breakwaters: sea-pods, gabions, and Z-walls. Specific information on the Shoreline Erosion Demonstration Project can be found in the Buffalo District "Geneva State Park, Ohio Shoreline Erosion Demonstration Project Preconstruction Report" dated February 1978. Construction of these offshore breakwaters was completed in the Fall of 1978. Currently a 5-year monitoring program (to be followed by an additional 5-year observation period) is being conducted to assess the effects of the different types of offshore breakwaters on preventing shoreline erosion.

As shown on Plate 5, the area selected for the demonstration project is in the Cowles Creek area which will be considered as an alternative site for the small-boat harbor. If the Cowles Creek area is selected for the harbor site, a joint decision between the State of Ohio and the Corps will be required to determine if a portion of the demonstration project should be removed or the construction of the harbor delayed until the demonstration project is completed.

A Reconnaissance Report on Shoreline Erosion of Lake Erie at Geneva State Park considered the feasibility of constructing shoreline protective works at the publicly-owned recreational complex. The report was prepared by the Buffalo District in November 1977 under the authority of Section 103 of the 1962 Rivers and Harbors Act. The report recommended the construction of groins near the western end of the park and in the Cowles Creek area. Plates 6 and 7 show the recommended groin locations.

The groins recommended at the western end of the park will not interfere with any of the alternative harbor sites being investigated herein. However, the groins recommended in the Cowles Creek area would interfere with the harbor if the Cowles Creek area is selected for the harbor location. The Section 103 Reconnaissance Report indicated that due to Buffalo District funding and manpower restraints, the groins could not be constructed until the final years of the Shoreline Erosion Demonstration Project. Since the site location for the small-boat harbor will be determined well in advance of this timeframe, ample coordination of the projects will be possible.

If a harbor plan is recommended for further study at the completion of this Stage 2 report, the effects the recommended harbor will have on the shoreline protective works outlined in the Section 103

Reconnaissance Report on Shoreline Erosion will be studied in detail and the results will be reported in Stage 3 documentation. In addition, if the Cowles Creek area is recommended for further study, the possibility of combining the planning requirmenets of both projects into one multiobjective planning project will be investigated. Construction of the projects would still be perfomed under their respective authorities.

In addition to the above-mentioned shoreline protection projects, the Ohio Department of Natural Resources has been involved in providing additional shoreline protective works at the State Park. These protective works include the installation of approximately 800 feet of steel sheet piling with gabions at the western end of the park and the construction of a concrete revetment and a small offshore breakwall in the vicinity of the bathhouse. The small-boat harbor study will avoid disruption of these protective works and the breakwaters will be designed to minimize any adverse effects they may have on these works.

# SECTION B
# PROBLEM IDENTIFICATION

The purpose of this section is to inform the reader of this report of the water and related resource problems and needs, or lack thereof, in the study area and for which this study seeks a solution. The section presents information on the existing physical, biological, and human environment in the study area; discusses the present demand for small-boat navigation and recreational fishing facilities; reviews the planning constraints under which this study was conducted; discusses the specific planning objectives of the study and reviews the conditions that would exist if no Federal action was taken.

## EXISTING CONDITIONS

The purpose of this section is to present the environmental setting without the project in order to assess impacts of the various alternatives on the existing environment. The information presented will provide a data base for impact assessment and evaluation purposes.

### Physical Environment

(1) Location - Geneva State Park is located on the south shore of Lake Erie about 17 miles east of Fairport Harbor, OH, and 12 miles west of Ashtabula Harbor, OH, as shown on Plate 1. The project site is located in the vicinity of Cowles Creek. The lake shoreline is generally straight, and the inland area consists of marshes and dunes.

(2) Physiography - Topography - The Ohio landscape along Lake Erie is part of the Erie-Ontario Lowlands Province. Largely shaped during the late Cenozoic, the province includes the flat, low-lying areas which border the southern shores of Lake Erie and extends approximately two to 50 miles inland where it is bordered on the south by the Appalachian Uplands Province. The lowlands rise gently to the east and south from an elevation of 570 msl at Lake Erie to about 700 to 1,000 msl along the Ashtabula Moraine which marks the southern limits of the province. Glacial deposition has left recessional moraines and shoreline deposits which modify the simple erosional topography. Land surfaces at the park rise abruptly forming bluffs 15-20 feet high near the shoreline. Elevation at the top of these bluffs is about 590 feet above msl.

(3) Cowles Creek Drainage Basin - Cowles Creek rises about six miles inland, flows northerly for 1.5 miles, westerly for four miles, then northerly to enter the lake at Geneva-on-the-Lake, about 18 miles east of the Grand River. It has a drainage area of 23 square miles.

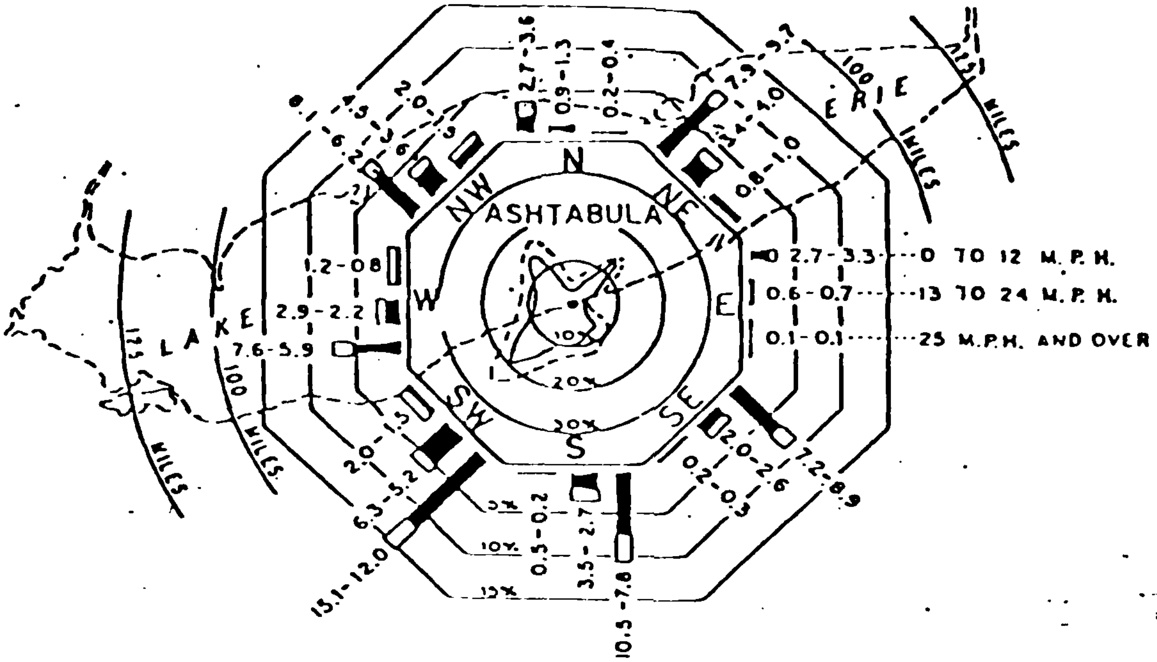
(4) Climate - The climate of the Geneva-on-the-Lake area is defined as "humid continental" and is characterized by large diurnal and annual fluctuations in temperature. Temperature extremes recorded at the nearest national weather service station at Geneva, OH, range from a summer time maximum of 98°F to a winter minimum of -17°F. Monthly average temperatures range from a low of 27°F during January to a high of 71°F during July. Some moderation of temperature extremes results from Geneva State Park's close proximity to Lake Erie.

Annual precipitation in the vicinity of the project area averages 39.07 inches with April being the wettest month (3.91 inches) and February the driest month (2.32 inches). Distribution of precipitation is quite even throughout the year.

Wind velocity is generally moderate with northwesterly and southwesterly prevailing winds. A wind diagram for Ashtabula, OH is shown on Figure 6.

(5) Geology - A thick sequence of sedimentary strata of the Paleozoic age exists in the northeast region of Ohio and is extensively mantled by Pleistocene glaciolacustrine and glacial till deposits. Precambriam crystalline basement rocks underlying the Paleozoic strata are chiefly gneiss and granites. Outcrops of Precambrian rocks are absent in Ohio as this surface lies about 5,000 feet below sea level. The shallowest bedrock in the area is the Chagrin Shale of Upper Devonian age. This shale formation is on the order of 1,000 feet thick and lies with a slight dip to the southeast. The Chagrin Shale underlies the lake bottom near shore, but is usually not exposed along the shoreline or in bluff areas. At the project site and in the offshore area, the bedrock surface is very close to the ground surface (from one-half foot to four feet below lake bottom).

Between Madison Township Park and Geneva-on-the-Lake, the bluffs are 10 to 12 feet high and composed almost entirely of silt and clay overlying the glacial till, the upper surface of which is just above lake level. Between Geneva-on-the-Lake and Walnut Beach Park, just west of Ashtabula Harbor, the bluffs gradually increase to a height of 30 to 50 feet and are composed almost entirely of glacial till. The general surficial sequence is till unconformably upon shale and overlain by glaciolacustrine silts. Glaciolacustrine sand and gravel deposits sometimes top the silt. The thickness and presence of each layer varies from location to location. On the average, approximately 25-30 percent of the material exposed in the bluffs is potential beach-building sediment. Lacustrine deposits exposed in the bluffs supply fine sand to beaches, while till supplies sand and coarser-sized material. The streams between Fairport and Ashtabula




# WIND DIAGRAM FOR ASHTABULA, OHIO

## NOTES

INDICATES DURATION FOR ICE-FREE PERIOD (MAR. TO DEC. INCL.) IN PERCENT OF TOTAL DURATION.

INDICATES DURATION FOR ICE PERIOD (JAN. TO FEB. INCL.) IN PERCENT OF TOTAL DURATION.

INDICATES PERCENT OF TOTAL WIND MOVEMENT OCCURRING DURING ICE-FREE PERIOD.

INDICATES PERCENT OF TOTAL WIND MOVEMENT OCCURRING DURING COMBINED ICE AND ICE-FREE PERIODS.

FIGURES AT ENDS OF BARS INDICATE PERCENT OF TOTAL WIND DURATION FOR ICE-FREE PERIOD AND COMBINED ICE-FREE AND ICE PERIODS, RESPECTIVELY.

WIND DATA BASED ON RECORDS OF THE U. S. COAST GUARD LIFE BOAT STATION AT ASHTABULA, OHIO FOR PERIOD 1 JAN. 1937 TO 31 DEC. 1968 INCL., LESS 1944, AND 1960.

**FIGURE 6**

carry little sand to the lake. Their drowned mouths act as settling basins for all but the very finest fractions.

(6) Soils - Soils in the project area are somewhat varied and reflect the geologic background of the area, their position in relation to topographic, climatic, and vegetational factors, and the interaction of time working on these elements. The facts most responsible for differences in the soils at Geneva State Park are parent material, topography, and alteration of original soils by human disturbances. Six soil types are found in the vicinity of Geneva State Park. A soils map depicting soil types is shown on Plate 8 of Appendix I. The area surrounding the bathhouse, the parking lot, and borrow pits (ponds) is classified as Madeland (Ma in the Soil Conservation Service series classification). Madeland comprises approximately 54 percent of the area and represents the dominant soil type. Conneaut silt loam (Ct) occupies 26 percent of the area, most of which is presently wooded. The Willette series (We) consists of mucky, black soil comprising 11 percent of the area. Holly silt loam (Hm), Platea silt loam (PsB), and Beaches (Be) occupy four percent, three percent, and two percent of the area, respectively. A brief description of the six soil types are as follows:

(a) Madeland (Ma) - Madeland consists of areas of earth fill, of borrow pits, and of areas where much of the soil surface is covered by streets, buildings, parking lots, or docks. In all of these areas, the original soils have been greatly altered.

(b) Willette muck (Wc) - The Willette series consists of black, mucky, level soils that are very poorly drained. These soils are formed in an accumulation of partly decomposed, saturated vegetative materials mixed with variable amounts of mineral material. They occupy low-lying bogs and swamps and are commonly adjacent to soils on flood plains.

(c) Conneaut silt loam (Ct) - The Conneaut series consists of deep, poorly drained, nearly level soils that formed partly in a silt loam mantle and partly in underlying silt loam glacial till. These soils occupy broad areas on the lake plain.

(d) Holly silt loam (Hm) - The Holly series consists of a dark-colored, poorly drained soil formed in recent alluvium deposited by flooding streams. Most areas of Holly soil are long and narrow and are on flood plains along streams.

(e) Platea silt loam, two to six percent slopes (PsB) - This series consists of loamy, nearly level to sloping soils that are somewhat poorly drained. These soils have a dense, compact layer, or fragipan, in the lower part of their subsoil. Platea soils formed in silt loam glacial till of Wisconsin age.

(f) Beaches (Be) - Beaches consist of sand and other coarse material washed up by waves along the shores of Lake Erie.

(7) Littoral Transport - In the study area, winds from the west through the northwest set up currents along the shore in a general west-to-east direction. Those from the north and northeast set up currents in the opposite direction. Offshore winds from the southwest through the southeast to the east have little effect on the littoral current. The wind diagram for Ashtabula Harbor, OH, shows that winds from the southwest, west, and northwest account for approximately 50 percent of the total wind duration and 59 percent of the total wind movement. Only 20 percent of the wind duration and 22 percent of the wind movements are accounted for by north and northeast winds. Predominant winds of high velocity are from the southwest through the west to the northwest and the northeast. Under the influence of this wind pattern, the prevailing and predominant littoral currents are from the west to the east, with temporary reversals in direction due to winds from the north and northeast. Accretion adjacent to shore structures confirms this analysis.

(8) Water Levels and Fluctuations - All depths mentioned, unless otherwise stated, are referred to low water datum for Lake Erie, which is 568.6 feet above mean water level at Father Point, Quebec. Water stages at Geneva-on-the-Lake are equivalent to and dependent upon the water surface of Lake Erie, which varies from year to year, but is subject to a seasonal rise and fall, the highest prevailing during the summer months, and the lowest during the winter months.

(9) Air Quality - According to an Ohio EPA publication titled "Ohio Air Quality - 1977," numerous substances are emitted into the air each year through human activities. Those substances which are added to the ambient (outside) air in quantities sufficient to cause harmful effects on humans are considered pollutants. At present there are five substances whose effects are known to be harmful at concentrations above the National Ambient Air Quality Standards. These five are Total Suspended Particulates (TSP), Sulfur Dioxide ($SO_2$), Nitrogen Dioxide $NO_2$), Carbon Monoxide (CO), and Photochemical Oxidants (Ozone). These substances are referred to as Criteria Pollutants, that is, substances for which air quality standards have been adopted by the U.S. Environmental Protection Agency. Air quality standards are also in effect for a sixth class of substances known as Non-Methane Hydrocarbons (NMHC). Though NMHC themselves are not considered harmful, a standard has been established in an attempt to control their involvement in the formation of dangerous Photochemical Oxidants such as Ozone. Table B1 shows the air quality standards in effect for these six pollutants.

Table 81 - Air Quality Standards, The State of Ohio

| Pollutant | Duration | Restriction | Ohio EPA Standards | USEPA Air Quality Standards Primary | Secondary |
|---|---|---|---|---|---|
| Suspended Particulates | Annual Mean (G) | Not to be exceeded | 60 | 75 | 60 |
| Suspended Particulates | 24-hour concentration | Not to be exceeded more than once per year | 150 | 260 | 150 |
| Sulfur Dioxide | Annual Mean (A) | Not to be exceeded | 60 (.02)** | 80 (.03) | -- |
| Sulfur Dioxide | 24-hour concentration | Not to be exceeded more than once per year | 260 (.10) | 365 (.14) | -- |
| Sulfur Dioxide | 3-hour concentration | Not to be exceeded more than once per year | -- | -- | 1,300 (.50) |
| Carbon Monoxide | 8-hour mean (A) concentration | Not to be exceeded more than one 8-hour period per year | 10* (9.0) | 10* (9.0) | 10* (9.0) |
| Carbon Monoxide | 1-hour mean (A) concentration | Not to be exceeded more than once per year | -- | 40* (35.0) | 40* (35.0) |
| Photochemical Oxidants | 1-hour mean (A) concentration | Not to be exceeded | 119 (0.06) | 235 (.12) | 235 (.12) |
| Photochemical Oxidants | 4-hour mean (A) concentration | Not to be exceeded more than one consecutive 4-hour period per year | 79 (0.04) | -- | -- |
| Photochemical Oxidants | 24-hour mean (A) concentration | Not to be exceeded more than one day per year | 40 (0.02) | -- | -- |
| Non-methane Hydrocarbons | 3-hour mean (A) concentration | Not to be exceeded between 6 a.m. and 9 a.m. | 126 (0.19) | 160 (.24) | 160 (.24) |
| Non-methane Hydrocarbons | 24-hour mean (A) concentration | Not be exceeded more than one day per year | 331 (0.50) | -- | -- |
| Nitrogen Dioxide | Annual mean (A) | Not to be exceeded | 100 (.05) | 100 (.05) | 100 (.05) |

(A) Arithmetic (G) Geometric
* Only standard expressed in milligrams per cubic meter
** Values in parentheses are equivalent values in parts per million
Values not in parentheses are in micrograms/cubic meter

Primary Standard - For Protection of Public Health
Secondary Standard - For Protection of Public Welfare

The U.S. Environmental Protection Agency, "Monitoring and Air Quality Trends Report, 1972," Dec. 1973, states that Geneva-on-the-Lake lies within Federally designated Air Quality Control Region (AQCR) #178. This AQCR was judged to have a priority one classification (most severe) with respect to particulates. Sulfur dioxide is rated as priority two (moderate) while both carbon monoxide and oxidant levels are rated as priority three.

(10) Biological Environment

(a) Terrestrial Habitat - The terrestrial habitat of the project area cannot be described at this stage. However, biological studies are being conducted by the U.S. Fish & Wildlife Service and the data will be utilized in a later study phase.

(b) Fisheries and Benthos - The aquatic life of the marsh-lake-creek complex has not been studied and cannot be detailed until completion of environmental investigations in the Fall of 1979.

(c) Endangered Species - A number of plant and animal species are protected as endangered species by both Federal Law and Ohio State Law. The Endangered Species Act of 1973 (16 U.S.C. 1531-1543; 87 Stat. 884) gives Federal protection to many endangered and threatened species, while Chapter 119 of the Ohio Revised Code gives similar protection to endangered species found within the State. Table B2 lists all Federally and State protected species from Ohio and gives an approximation of their possible occurrence within the Geneva-on-the-Lake area. Of the 20 species listed, the Four-toed salamander (Hemidactylium scutatum) is listed as a highly possible resident breeder and the spotted turtle (Clemmys guttata) is listed as having a medium possibility of occurring as a resident breeder. In addition, eight other species have a low possibility of being found in the area as breeders. Four species of birds and five species of fish may be found to utilize the area, primarily as transient visitors.

Animals become endangered because their habitat is destroyed or they are overharvested from the wild due to improper regulations, lack of regulations, or poor enforcement of regulations. Habitat destruction is by far the most serious problem faced by endangered species in the State of Ohio. As described in a publication by ODNR Division of Wildlife entitled "Ohio's Endangered Wild Animals," the types of habitat loss most critical in Ohio are summarized as follows:

1. Loss of Ohio's formerly vast forest areas. Land clearing for agriculture and the extensive use of the forest for charcoal in the iron industry were major early causes of forest removal. Recovery of our forest lands has been significant, but recovery of forest wildlife in some cases may not be possible. This is true for species

Table B2 - Endangered Species, Geneva-on-the-Lake, OH

| Common Name | Scientific Name | Protection | Possibility of Occurrence in Geneva-on-the-Lake, OH: Resident non-Breeding H | M | L | Resident Breeding H | M | L | Transient H | M | L | None | Unknown |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **MAMMALS** | | | | | | | | | | | | | |
| River otter | Lutra c. canadensis | Ohio | | | | | | | | | | X | |
| Bobcat | Felis r. rufus | Ohio | | | | | | | | | | X | |
| Indiana bat | Myotis sodalis | Ohio, Fed. | | | | | | X | | | | | |
| Allegheny woodrat | Neotoma floridana magister | Ohio | | | | | | | | | | X | |
| **BIRDS** | | | | | | | | | | | | | |
| American peregrine falcon | Falco peregrinus anatum | Ohio, Fed. | | | | | | | | | X | | |
| Sharp-shinned hawk | Accipiter striatus velox | Ohio | | | | | | X | | | | | |
| Bald eagle | Haliaeetus leucocephalus | Ohio, Fed. | | | | | | | | | X | | |
| King rail | Rallus e. elegans | Ohio | | | | | | X | | | | | |
| Kirtland's warbler | Dendroica kirtlandii | Ohio, Fed. | | | | | | | | | X | | |
| Upland sandpiper | Bartramia longicauda | Ohio | | | | | | X | | | | | |
| Common tern | Sterna h. hirundo | Ohio | | | | | | | | | X | | |
| **REPTILES** | | | | | | | | | | | | | |
| Spotted turtle | Clemmys guttata | Ohio | | | | | X | | | | | | |
| Northern copperbelly | Natrix erythrogaster neglecta | Ohio | | | | | | | | | | X | |
| Eastern plains garter snake | Thamnophis r. radix | Ohio | | | | | | | | | | X | |
| **AMPHIBIANS** | | | | | | | | | | | | | |
| Blue-spotted salamander | Ambystoma laterale | Ohio | | | | | | X | | | | | |
| Green salamander | Aneides aeneus | Ohio | | | | | | | | | | X | |
| Cave salamander | Eurycea lucifuga | Ohio | | | | | | | | | | X | |
| Four-toed salamander | Hemidactylium scutatum | Ohio | | | | X | | | | | | | |
| Wehrle's salamander | Plethodon wehrlei | Ohio | | | | | | | | | | X | |
| **FISH** | | | | | | | | | | | | | |
| Ohio lamprey | Ichthyomyzon bdellium | Ohio | | | | | | | | | | X | |
| Northern brook lamprey | Ichthyomyzon fossor | Ohio | | | | | | | | | | X | |
| Allegheny brook lamprey | Ichthyomyzon greeleyi | Ohio | | | | | | | | | | X | |
| Silver lamprey | Ichthyomyzon unicuspis | Ohio | | | | | | X | | | | | |
| American brook lamprey | Lampetra lamottei | Ohio | | | | | | | | | | X | |
| Lake sturgeon | Acipenser fluvescens | Ohio | | | | | | | | | X | | |

Notes: H-High, M-Medium, L-Low

Source: ODNR

Table B2 - Endangered Species, Geneva-on-the-Lake, OH (Cont'd)

| Common Name | Scientific Name | Protection | Possibility of Occurrence in Geneva-on-the-Lake, OH: Resident non-Breeding H | Resident non-Breeding M | Resident non-Breeding L | Resident Breeding H | Resident Breeding M | Resident Breeding L | Transient H | Transient M | Transient L | None | Unknown |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **FISH** | | | | | | | | | | | | | |
| Paddlefish | *Polyodon spathula* | Ohio | | | | | | | | | | X | |
| Spotted gar | *Lepisosteus oculatus* | Ohio | | | | | | | | | | X | |
| Shortnose gar | *Lepisosteus platostomus* | Ohio | | | | | | | | | | X | |
| Mooneye | *Hiodon tergisus* | Ohio | | | | | | | | | | X | |
| Cisco | *Coregonus artedii* | Ohio | | | | | | | | | X | | |
| Great Lakes muskellunge | *Esox m. masquinongy* | Ohio | | | | | | | | | X | | |
| Rosyide dace | *Clinostomus funduloides* | Ohio | | | | | | | | | | X | |
| Tonguetied minnow | *Exoglossum laurae* | Ohio | | | | | | | | | | X | |
| Bigmouth shinner | *Notropis dorsalis* | Ohio | | | | | | | | | | X | |
| Pugnose minnow | *Notropis emiliae* | Ohio | | | | | | | | | | X | |
| Bigeye shiner | *Notropis boops* | Ohio | | | | | | | | | | X | |
| Ghost shinner | *Notropis buchanani* | Ohio | | | | | | | | | | X | |
| Blacknose shiner | *Notropis heterolepis* | Ohio | | | | | | | | | | X | |
| Silver chub | *Hybopsis storeriana* | Ohio | | | | | | X | | | | | |
| Longnose sucker | *Catostomus catostomus* | Ohio | | | | | | X | | | | | |
| Greater redhorse | *Moxostoma valenciennesi* | Ohio | | | | | | | | | | X | |
| Blue sucker | *Cycleptus elongatus* | Ohio | | | | | | | | | | X | |
| River redhorse | *Moxostoma carinatum* | Ohio | | | | | | | | | X | | |
| Lake chubsucker | *Erimyzon sucetta* | Ohio | | | | | | | | | | X | |
| Scioto madtom | *Noturus trautmani* | Ohio, Fed. | | | | | | | | | | X | |
| Northern madtom | *Noturus stigmosus* | Ohio | | | | | | | | | | X | |
| Mountain madtom | *Noturus eleutherus* | Ohio | | | | | | | | | | X | |
| Pirate perch | *Aphredoderus sayanus* | Ohio | | | | | | | | | | X | |
| Burbot | *Lota lota* | Ohio | | | | | | | | | X | | |
| Banded killifish | *Fundulus diaphanus* | Ohio | | | | | | | | | | X | |
| Iowa darter | *Theostoma exile* | Ohio | | | | | | | | | | X | |
| Longhead darter | *Percina macrocephala* | Ohio | | | | | | | | | | X | |
| River darter | *Percina shumardi* | Ohio | | | | | | | | | | X | |
| Eastern sand darter | *Ammocrypta pellucida* | Ohio | | | | | | | | | | X | |
| Channel darter | *Percina copelandi* | Ohio | | | | | | | | | | X | |
| Blue pike | *Stizostedion vitreum glaucum* | Ohio, Fed. | | | | | | | | | X | | |
| Tippecanoe darter | *Etheostoma tippecanoe* | Ohio | | | | | | | | | | X | |
| Slenderhead darter | *Percina phoxocephala* | Ohio | | | | | | | | | | X | |
| Spotted darter | *Etheostoma maculatum* | Ohio | | | | | | | | | | X | |
| **CRUSTACEANS** | | | | | | | | | | | | | |
| Allegheny crayfish | *Orconectes obscurus* | Ohio | | | | | | | | | | X | |

Table B2 - *Endangered Species, Geneva-on-the-Lake, OH (Cont'd)*

| Common Name | Scientific Name | Protection | Possibility of Occurrence in Geneva-on-the-Lake, OH | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Resident non-Breeding | | | Resident Breeding | | | Transient | | | | |
| | | | H | M | L | H | M | L | H | M | L | None | Unknown |
| MOLLUSKS | | | | | | | | | | | | | |
| Cob shell | Quadrula cylindrica | Ohio | | | | | | | | | | X | |
| Club shell | Pleurobema clava | Ohio | | | | | | | | | | X | |
| Fan shell | Cyprogenia stegaria | Ohio | | | | | | | | | | X | |
| Orb mucket | Lampsilis orbiculata | Ohio, Fed. | | | | | | | | | | X | |
| White cat's paw | Epioblasma sulcata perobliqua | Ohio, Fed. | | | | | | | | | | X | |
| Northern riffle shell | Epioblasma torulosa rangiana | Ohio | | | | | | | | | | X | |
| Simpson's shell | Simpsonaias ambigua | Ohio | | | | | | | | | | X | |
| Ridged pocketbook | Lampsilis ovata | Ohio | | | | | | | | | | X | |
| Yellow sand shell | Lampsilis teres | Ohio | | | | | | | | | | X | |
| Fragile heel-splitter | Potamilus laevissiumus | Ohio | | | | | | | | | | X | |
| Nodule shell | Quadrula nodulata | Ohio | | | | | | | | | | X | |
| Monkeyface | Quadrula metanevra | Ohio | | | | | | | | | | X | |
| Bullhead | Plethobasus cyphyus | Ohio | | | | | | | | | | X | |
| Butterfly | Plagiola lineolata | Ohio | | | | | | | | | | X | |
| Long-solid | Fusconaia maculata = subrotunda) | Ohio | | | | | | | | | | X | |
| Ohio pig-toe | Pleurobema cordatum | Ohio | | | | | | | | | | X | |

such as mountain lions and timber wolves, which require large areas with little human disturbance.

2. Loss of wetland areas and swamp forests, particularly along Lake Erie and in glaciated Ohio. These lands have been drained to convert the land to agricultural production and for residential and urban development. Typical endangered species needing these types of areas are king rails, spotted turtles, and blue-spotted and four-toed salamanders.

3. Contamination by chemicals. Several pesticides such as DDT and dieldrin and industrial chemicals such as polychlorinated biphenyls (PCB's) have been important causes of reproductive failure in Ohio bald eagles. The sharp-shinned hawk is another endangered species affected by these types of chemicals.

(d) Wetlands - A preliminary survey of the wetland area was conducted by Corps biologists on 30-31 May 1979. The purpose of the survey was to define the major habitats in and around the wetland, and to describe the vegetation characteristic of the major habitat types. The following information is based on a subjective evaluation of the site, but nevertheless gives an accurate account of the biological resources of the project area. A total of 12 habitat types were found in the area and are listed as follows:

1. Open Water (pond) Habitat
2. Marsh Habitat
3. Seasonally Flooded Woodland Habitat
4. Wet Meadow Habitat
5. Terrestrial Woody Vegetation - Hardwood Forest Habitat
6. Stream Habitat (Lotic & Lentic)
7. Island & Peninsula Habitat
8. Terrestrial Shrubs and Herbaceous Habitat
9. Creek Habitat
10. Managed Grassland Habitat
11. Sand Plain Habitat
12. Lake Habitat

The open water habitat is classified as the pond areas (see Plate 9 in Appendix I), with a very sparse cover of floating aquatic plants. Duckweed and Spatterdock were the only two floating aquatics observed during the survey. Water clarity in the ponds was very poor, probably due to the high amount of clay particles that remain in colloidal suspension. The high turbidity in the two ponds probably accounts for the limited density and diversity of aquatic plant species. The vegetation growing just above water level around the smaller pond can be characterized as a narrow fringe of robust

emergents composed of Phragmites, Sedges, Rushes, Cattail, and various less dominant species. Farther above this narrow band of vegetation is a composition of shrubby growth consisting generally of Dogwood, Staghorn Sumac, Cottonwood, Arrowwood Viburnum, and Multiflora Rose. Plant species density and diversity is high, with evidence of various successional vegetational changes occurring. The vegetation surrounding the larger pond exhibited the same high diversity as the smaller pond, however, species structure and composition differed significantly. The peninsula or projecting island of the larger pond is in a dynamic intermediate successional stage. This area is basically an entanglement of many shrubs and vines with scattered Cottonwoods and Willow. A rather dense stand of Jewelweed was also noted as a major dominant ground cover on the peninsula. The band of vegetation surrounding the larger pond consists of a sparse cover of Sedges, Willows, and Rushes at water line. Above water level, many species of forbs and assorted grasses occur. Some species noted in high numbers were: Sweet Clover, Wild Strawberry, Dewberry, Goldenrod, Apple, and Dogwood. Along the north side of the pond a very dense cover of Arrowwood Viburnum interspersed with Sumac occurs, with Ash being the overstory species.

The marsh habitat consists of moderately wet areas with some very shallow open water pockets and numerous interconnecting channels characterized by monocotyledons such as grasses and cattails. Species composition and association in the marsh is greatly influenced by water level fluctuations. The degree of wetness reflects the type of species present and their distribution patterns. The soil moisture content, therefore, appears to be the most influential factor in the vegetational composition of the area. In addition, many of these plants are modifying their own environment by such biological processes as growth and decomposition, which can account for vegetational changes that occur. The interdispersion of plants and the interconnecting water channels throughout the marsh is extremely important for the life support of many animals that utilize the area.

The seasonally flooded woodland habitat is located to the south of the study area and has the general appearance of being swamp-like. The area is rather unique in that White Ash is the dominant overstory with Dogwood comprising a very dense understory and Spatterdock forming a thick mat over the water surface. Since the area was extremely difficult to walk through, all observations of the habitat were made at the edge.

The stream habitat in the study area is classified as having both fast-moving and sluggish water. The southern portion of the site has a relatively fast-flowing stream with a small population of fish and many other aquatic organisms. This lotic environment eventually fans

out to an environment where a portion of the marsh habitat with its interconnecting channels of slow-moving water can be found. The bottom is very soft because it is composed of rather fine particles.

The terrestrial shrubs and herbaceous habitat is dispersed throughout the entire study area and represents different successional stages in development. The area around the outlet end of the marsh is dominated by Cottonwood and Willow trees with dense clumpings of Blackberry and Honeysuckle. A rather large patch of Horsetail was found near the outlet end with other clumpings of assorted grasses. Where the outer fringes of the marsh join the terrestrial woody herbaceous habitat, many Iris plants could be found.

At the time of the survey, the outlet end of the wetland was open to the lake, and a relatively fast flow of water was moving out of the marsh. From general observations of the area, it is apparent that the wetland is functioning like a sponge, holding large amounts of water and probably retaining many nutrients as well. It is quite probable that the wetland is acting as a filter to cleanse the upper watershed water before discharging it into the lake.

The wet meadow habitat located to the west of the parking lot surrounds the smaller marsh-like pond. Dominant species in this area are Verrain, Rushes, Sedges, and Goldenrod. Here again, soil moisture seems to be the influential factor in the distribution of these plant species. The wet meadow habitat blends into the managed grassland which is composed of an almost homogeneous stand of Tall Fescue.

An advancing climax hardwood forest surrounds most of the wetland and adds diversity to the area. No survey was made of the hardwood forest. Many species of birds were noted on the fringes of the woodland and in the marsh complex itslf. Some of the birds observed are listed as follows: Red-winged Blackbird, Field Sparrow, Song Sparrow, Yellow-shafted Flicker, Great Blue Heron, Yellow Warbler, Canada Goose, Vulture, and Catbird. A rather large population of Red-winged Blackbirds were observed in the marsh areas, especially in the Cattails.

The sand plain habitat is the beach area along Lake Erie. Some vegetation exists in this dry habitat, although most species are confined to the uppermost part of the beach. Sea Rocket, a water-dispersed plant, was found growing in this sand habitat.

In summary, it would appear that the interdispersion and juxtaposition of these habitat types are the key factors in the rich diversity of life in this area. Loss of wetland areas and swamp forests, particularly along Lake Erie has been identified as a major contemporary environmental problem. The indirect environmental effects of

a boat harbor in this area would need to be evaluated more closely because of the unique and critical habitats that exist in the area.

Human Environment

(1) Land Use - Geneva and Geneva-on-the-Lake are primarily residential communities with many summer cottages. Geneva-on-the-Lake is also a summer resort area. Many small shops, restaurants, motels, and rented cottages are located along Ohio Route 531, east of the State Park. The villages and the park cater to a large volume of transient vacationers who generally remain in the area for one to two weeks. Additional persons visit the area on weekends and holidays.

Major land use in Ashtabula County remains agricultural-rural. In 1971, 92.4 percent of all land use was agricultural-rural; in 1977 it declined to 89.4 percent. Plate 10 depicts a generalized land use map for Ashtabula County (1977) provided by the Ashtabula County Planning Commission in a publication titled "Ashtabula County Land Use, 1977."

(2) Demography - According to 1970 U.S. Census data, the city of Geneva had a population of 6,449, while the village of Geneva-on-the-Lake had a population of 877. The 1970 population of Ashtabula County was 98,237, an increase of 5.6 percent since 1960. Ashtabula County has shown consistent population gains over the past three decades, achieving its highest historical population in 1970. However, its current growth rate is just slightly more than half the Ohio average of 9.8 percent, a trend influenced by a net outward migration of 3.5 percent, which is almost three times the State average. The age distribution and sex ratio in Ashtabula County are comparable to those of Ohio, with a slightly higher percentage of its population over 65 years of age (10.2 versus 9.4 percent). According to a 1972 report by the Ashtabula County Planning Commission, the future population of Ashtabula County is projected to be 111,743 in 1980, 126,826 in 1990, and 135,520 in the year 2000, a 41 percent net increase over the next three decades.

Ashtabula County has a small, non-white population of 2,818 or 2.9 percent of the total population. Approximately 16 percent of the county's population is of foreign stock, while Ohio as a whole has a lower proportion of foreign stock at 12.3 percent.

(3) Housing and Structures - As of 1970, housing units in Ashtaula County totaled 33,835. Of these, 23,250 were listed as owner-occupied, with a 1970 median value of $14,000. The city of Geneva had a total of 1,979 housing units as of 1970, of which 1,352 were occupied by their owners. Median price asked for housing in Geneva in 1970 was a very low $9,400, indicating a depressed housing

market in the city. Due to the small size of the village of Geneva-on-the-Lake, specific housing statistics are not readily available. Conversations with the village's Chamber of Commerce indicate that although much of the housing in the area is of relatively poor quality for use as year-round residences, housing is generally in short supply due to a large increase in population (estimated at about 50 percent) over the past three years. Many of these housing units were originally intended as primarily summer residences or cottages.

(4) Business and Industry - The city of Geneva, as of 1972, had 126 retail establishments with total sales in excess of $27,000,000. Of these, over half were listed as sole proprietorships. According to the Geneva City Manager's Office, the single largest employer in Geneva is the True Temper Corporation, which manufactures sporting goods and accessories and employs several hundred workers. Remaining businesses in the area are relatively small, employing less than 50 workers each.

Information supplied by the Chamber of Commerce in Geneva-on-the-Lake indicates that the major industry in that area is tourism, including cabin rental, boat and equipment sales and rentals, and related businesses.

(5) Employment and Income - As of 1970, employed persons 16 years old and over in Ashtabula County totaled 36,562, including 12,650 female employees. Employed persons classified as operatives comprised the single largest occupation group in the county, totaling 8,203, followed by craftsmen and foremen (6,223), clerical and kindred workers (4,645), service workers (3,772), professional and technical workers (3,680), managers and administrators (2,902), and sales workers (2,155).

As of 1969, median income for males 16 years and over with earnings was $8,150, while median income for females in the same cateogry was $3,388. Those employees classified as professional, managerial, and kindred workers in Ashtabula County had, as a group, the highest median income at $9,837, followed by craftsmen and foremen ($8,983), operatives ($7,718), and laborers ($5,722).

The unemployment rate in Ashtabula County, as of 1970, was approximately 4.0 percent, or just slightly higher than the 3.9 percent unemployment rate for the entire State of Ohio.

(6) Transportation - Geneva-on-the-Lake and Geneva State Park are readily accessible from the south by State Route 534, which joins U.S. Route 20 and Interstate Route 90 to the south, and from the east on State Route 531, which has connections with State Route 11 and

U.S. Route 20 to the east. Interstate 90 and U.S. Route 20 both run generally east and west and have connections with major urban areas including Cleveland to the west and Erie and Buffalo to the east. State Route 11 is a divided highway which runs generally north and south and joins other major highways and the city of Youngstown to the south.

(7) Utilities - The Cleveland Electric Illuminating Company supplies electricity to both Geneva and Geneva-on-the-Lake, and the East Ohio Gas Company is responsible for natural gas distribution in both communities. In addition, both communities have their own self-contained sewage treatment plants.

Water service is supplied to both Geneva and Geneva-on-the-Lake by the Ohio Water Service Company. The company has one intake structure located in four to 10 feet of water about 1,250 feet from the shoreline, east of the State Park. The overall availability of groundwater in Ashtabula County is very limited. Yields are generally never greater than around five gpm, even though the county has at least 1,900 logged wells.

The Western Reserve Telephone Company provides local service to area residents, while the Ohio Bell System handles long distance telephone operations.

(8) Recreational Resources - Geneva State Park is located at the northwestern corner of Ashtabula County, approximately 44 miles east of Cleveland and 26 miles west of the Ohio-Pennsylvania border. The park is a State-owned property administered by the Ohio Department of Natural Resources (ODNR), Division of Parks and Recreation. The park has about 1-1/2 miles of shoreline along Lake Erie. In addition to the facilities within the park, there are several golf courses, camping areas, and other recreational areas located nearby. The park is easily accessible from Interstate 90 and State Route 534 through the town of Geneva and the village of Geneva-on-the-Lake.

The Ohio Department of Natural Resources has developed a master plan for development of Geneva State Park. This plan includes extensive campgrounds, a small-boat harbor, a nature center, hiking trails, and bathing and parking facilities, as shown on Plate 2, all of which will add considerably to the park's value as a prime recreational resource. The closest public recreational beaches to Geneva State Park are at Ashtabula, OH, which is located approximately 12 miles to the east, at Presque Isle Peninsula in Erie, PA, located about 44 miles to the east, and at Headlands State Park in Mentor, OH, which is approximately 18 miles to the west. According to ODNR's "Statewide Plan for Outdoor Recreation in Ohio, 1971-1977," there are approximately 800 boat slips available in the area surrounding

Geneva-on-the-Lake. Of these, 300 are located at Conneaut, OH, which is approximately 20 miles to the east, and approximately 500 are located at Ashtabula, OH, and vicinity, 12 miles to the east; as shown on Plate 11.

Attendance figures furnished by the ODNR indicate that peak attendance at Geneva State Park occurred in Fiscal Year 1976 with a total attendance of 213,116. Figures since 1973 show a dramatic decrease in numbers of recreators engaged in swimming activities, down from a high of 41,128 in 1973 to 4,632 in 1975. However, 1976 showed an equally dramatic increase in swimming recreators totaling 20,387; more than quadrupling the 1975 figure. It is postulated that the decrease in swimming recreators is a result of the loss of the beach area caused by high lake levels on Lake Erie since 1973.

(9) Cultural Resources - In order to assess the impact of this project on known cultural resources, the National Register of Historic Places (NRHP) dated 6 February 1979 and all subsequent revisions through 17 July 1979, were consulted. There are no sites listed on or determined eligible for inclusion on the National Register. The area representative of the Ohio State Historic Preservation Officer commented in a letter dated 3 November 1979, that while there are no known cultural resource sites recorded within the proposed project area, a reconnaissance level survey is recommended. In addition, a cursory survey of the area was conducted by the archaeologist on staff at the Buffalo District on 6 June 1979. While no evidence of cultural resources was discovered, the great environmental diversity of the area and its proximity to Cowles Creek, make it highly probable that archaeological sites exist within the project area.

## PROBLEMS, NEEDS, AND OPPORTUNITIES

### Recreational Small-Boat Needs

In its present condition, Geneva State Park offers no recreational facilities for boaters who desire to use Lake Erie. The closest facilities are located in Ashtabula Harbor, OH, approximately 12 miles to the east and in Fairport Harbor, OH, approximately 17 miles to the west. However, the existing facilities for recreational boating at these two harbors are currently utilized to full capacity with long waiting lists for permanent dock space.

The Ohio Department of Natural Resources has stated that they consider development of a small-boat harbor facility at Geneva State Park imperative to promoting optimum use of the park and to satisfying the large-scale demand of prospective and existing small-boat owners in the northeast section of the State of Ohio. They have also stated that this project is one of the top priorities of their

department and they have spent considerable time and effort in petitioning Congress to appropriate the necessary funding to initiate this Phase I GDM study.

At the initial public meeting for this study on 22 March 1978, local interests expressed their desires for a small-boat harbor at Geneva State Park and requested that construction of this project be undertaken at the earliest possible time. They stated that there is presently an unfulfilled demand for additional permanent mooring facilities in the area and for additional public launching facilities. They consider Geneva State Park as an ideal location for a small-boat harbor to satisfy this demand because of its quiet setting, away from the commercial shipping activities of the other harbors in the area. Local interests also stated that they consider a small-boat harbor at Geneva State Park a prerequisite to attracting tourists and travelers to their resort area and, thus, enhance the area economy.

As part of this Stage 2 planning effort, Buffalo District personnel conducted a regional boating demand analysis to forecast existing and future demand for permanent boat moorings and trailered-boat launching facilities in the Ashtabula County area. This demand forecast was developed by a multi-step process which analyzed various current and projected socioeconomic variables (such as income level, household size, leisure time, and population,) travel time and alternate site factors to arrive at peak-day participation rates for boating in Ashtabula County. These participation rates were projected to the year 2030 in 10-year intervals. The participation rates were then converted to number of boats based on a 2.46 persons per boat conversion rate. The number of boats that would require permanent moorings and the number of boats that would be trailered was then determined by assuming that 90 percent of all boats under 16 feet in length would be trailered (the number of boats under 16 feet in length was determined based on the percentage of boats currently registered in the State of Ohio which are under 16 feet.) The final step was to determine the number of boats which would use Lake Erie facilities and what boats would use inland facilities based on the existing proportion of facilities in the county. A detailed description of this procedure is included in Appendix D, "Economic Evaluation."

The results of the regional boating demand analysis are presented in Tables B3 and B4. These tables do not include the effects of the proposed U. S. Steel plant at Conneaut, OH, since it is not known at this time whether or not this plant will be built. As discussed in Appendix D, a second demand forecast was developed based on the assumption that the plant would be built. In general, this new demand forecast indicated greater demand for permanent moorings and

Table B3 - Demand for Permanent Moorings on Lake Erie in Ashtabula County for Scenario 1 1/

| Year | Power Boats | Sail Boats | Total |
|---|---|---|---|
| 1970 | 800 | 130 | 930 |
| 1980 | 960 | 150 | 1,110 |
| 1990 | 1,100 | 190 | 1,290 |
| 2000 | 1,200 | 210 | 1,410 |
| 2010 | 1,300 | 250 | 1,550 |
| 2020 | 1,390 | 270 | 1,660 |
| 2030 | 1,460 | 290 | 1,750 |

1/ Does not include the effects of the proposed U. S. Steel plant at Conneaut, OH.

Table B4 - Demand for Peak-Day Trailered Boat Launchings on Lake Erie in Ashtabula County for Scenario 1 1/

| Year | Power Boats | Sail Boats | Total |
|---|---|---|---|
| 1970 | 1,450 | 230 | 1,680 |
| 1980 | 1,720 | 280 | 2,000 |
| 1990 | 1,980 | 330 | 2,310 |
| 2000 | 2,150 | 390 | 2,540 |
| 2010 | 2,350 | 430 | 2,780 |
| 2020 | 2,500 | 470 | 2,970 |
| 2030 | 2,660 | 510 | 3,170 |

1/ Does not include the effects of the proposed U. S. Steel plant at Conneaut, OH.

peak-day launchings with the proposed plant when compared to conditions without the plant. However, for this Stage 2 report the effects of the proposed steel plant will not be considered.

The demand forecasts presented in Tables B3 and B4 must be compared to the existing supply in Ashtabula County along the Lake Erie shoreline. At the present time, there are approximately 800 permanent mooring spaces and 14 launch ramps with a peak-day capacity of 560 launchings in the area. As can be inferred from the demand forecasts, these facilities are currently used to capacity. The tables also indicate that an appreciable demand for additional boat launching facilities and permanent berths exists in the Ashtabula County area.

## Public Safety

Hazards to small-boat navigation exist due to the absence of a harbor or natural shelter in the 29-mile reach of Lake Erie between Ashtabula and Fairport Harbor. Due to the rapid generation of heavy wave action on this relatively shallow lake, small boats cruising in this unprotected area may have too great a distance to travel to safety. This problem becomes more critical with each passing year as more and more recreational craft take to Lake Erie.

Public sentiment expressed at the initial public meeting for this study favored construction of a harbor-of-refuge at Geneva State Park. The Geneva-on-the-Lake Fire Department stated that they consider construction of a harbor-of-refuge essential to providing the required emergency facilities for their resort area. In addition, the Ohio Department of Natural Resources has stated that construction of a harbor-of-refuge at Geneva State Park would be a major step in completing Ohio's program to establish a harbor-of-refuge at least every 15 miles along the Lake Erie shoreline.

## Recreational Fishing Needs

At the initial public meeting for this study local interests expressed a need for additional recreational fishing facilities along Lake Erie. As part of this Stage 2 study, Buffalo District personnel, therefore, conducted a regional fishing demand analysis. The same procedure used to estimate regional boating demand was also used to estimate regional fishing demand except that participation rates were developed for peak-day fishing activities instead of participation rates for boating. A description of this procedure is included in Appendix D, "Economic Evaluation." The results of this regional fishing demand analysis are presented in Table B5.

The State of Ohio, in their 1975 Statewide Comprehensive Outdoor Recreation Plan (SCORP), estimates the existing peak-day capacity in Ashtabula County along Lake Erie as 2,400 fishing activity days. As can be seen from Table B5, this significantly exceeds the demand determined herein. Therefore, it appears that additional land-based fishing facilities are not warranted for the Geneva project. Because of the apparent conflict between the results of the regional fishing demand analysis and the need for additional recreational fishing facilities as expressed at the initial public meeting, the demand analysis will be reevaluated in Stage 3. If the reanalysis shows a lack of justification for breakwater fishing, that purpose will be eliminated from the project.

Table B5 - Demand for Peak-Day Fishing Activity Days on Lake Erie in Ashtabula County 1/

| Year | Demand |
|---|---|
| 1970 | 760 |
| 1980 | 930 |
| 1990 | 1,070 |
| 2000 | 1,200 |
| 2010 | 1,320 |
| 2020 | 1,430 |
| 2030 | 1,570 |

1/ Does not include the effects of the proposed U. S. Steel plant at Conneaut, OH.

## Shoreline Erosion

As discussed previously, a Reconnaissance Report on Shoreline Erosion of Lake Erie at Geneva State Park identified a need for shoreline protective works at Geneva State Park due to shoreline erosion. Although this Stage 2 investigation did not consider solutions to this shoreline erosion problem, every effort was made to minimize the effects of the harbor alternatives on the shoreline processes. As explained in Section C of the Main Report, this included incorporating a sand bypass system into each alternative formulated.

## PLANNING CONSTRAINTS

During this Stage 2 study several planning constraints were identified which impacted on the formulation of alternative plans developed to satisfy the water-related needs of the study area. These planning constraints included the following: (1) environmental constraints; (2) site location; (3) top-of-rock; and (4) harbor capacity. These constraints are reviewed below.

### Environmental Constraints

As stated previously, the authorized project is located within the boundaries of an existing wetland area and its modification or elimination poses severe environmental concerns. In addition, Executive Order 11990, issued 24 May 1977, has placed increased emphasis on preservation of wetlands. This Executive Order states that: ". . . Each agency shall provide leadership and shall take action to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities for . . . providing Federally undertaken, financed, or assisted construction and improvements . . . each agency shall avoid undertaking or providing assistance for new construction located in wetlands unless the head of the agency finds (1) that there is no practicable alternative to such construction, and (2) that the proposed action includes all practicable measures to minimize harm to wetlands which may result from such use. In making this finding the head of the agency may take into account economic, environmental, and other pertinent factors . . ."

The U. S. Fish and Wildlife Service has expressed their concern over destruction or modification of the existing wetland area. At the initial workshop meeting for this study on 15 December 1977 they stated that agency would oppose any project that destroys the wetland area, but that they would consider mitigation measures. They reemphasized their concern over destruction of the existing wetland area in their preliminary and final "Planning Aid Letter" and during their review of the alternatives formulated for this Stage 2 report.

During the course of this Stage 2 study every effort was made to eliminate or reduce the impacts of the formulated alternatives on the existing wetland area. As discussed in Section C of the Main Report (Formulation of Alternative Plans), alternatives were formulated outside the wetland area in due regard to the other planning constraints as discussed below. In addition, when formulated alternatives impacted on a portion of the wetland area every effort was made to minimize this impact.

For all plans that impacted on a portion of the wetland area suitable mitigation measures were considered to be an integral part of the plan. However, due to the lack of current biological information in the study area a specific mitigation plan could not be developed for this Stage 2 report. (The data required to develop a suitable mitigation plan will be available in the Fall of 1979). If the recommendation of this report is to continue the study into Stage 3 planning and the alternative (or alternatives) selected impact on a portion of the wetland area, suitable mitigation measures will be incorporated into the alternative and their effectiveness in preserving the environment will be assessed in the Environmental Impact Statement.

Site Location

At the initial workshop meeting for this study on 15 December 1977, the Ohio Department of Natural Resources, the local sponsor for the project, stated that they were opposed to acquiring any additional land outside the boundaries of the State Park for a small-boat harbor. They also stated that due to existing and future park development, the only area available for a small-boat harbor was between Cowles Creek and the wetland area. Therefore, with the exception of a possible mitigation site at Wheeler Creek, all alternatives formulated for this Stage 2 report were limited to the area between Cowles Creek and the wetland area at Geneva State Park.

ODNR also voiced its opposition to disruption of any existing park facilities such as the parking lot and the pedestrian foot bridge crossing Cowles Creek and any interference with the access to the existing bathhouse due to construction of a small-boat harbor. It was not possible, however, to formulate a harbor alternative that did not impact on either the existing wetland area or the existing park facilities in the area identified by ODNR for the small-boat harbor site. Therefore, for this Stage 2 report, various alternatives were formulated that had varying degrees of impact on the wetland area and on the existing park facilities in order that a compromise solution would be identified which had the least environmental impact while avoiding major disruption to existing park facilities.

Top-of-Rock

The final location, size, and shape of a small-boat harbor at Geneva State Park will be highly dependent on the location of top-of-rock which is near the earth's surface in much of the area. The location of the authorized project was chosen to minimize the amount of rock excavation and consequently minimize the construction cost of the project. Rock probings indicated that the authorized project could be constructed with little or no rock excavation. Any alternative

location to the authorized project location must also minimize the amount of rock excavation because of associated high construction costs (rock excavation cost approximately $18.00/cy and earth excavation cost approximately $3.25/cy) that could jeopardize the economic feasibility of a small-boat harbor at Geneva State Park.

As previously discussed, the Corps undertook a seismic survey of the study area through a contract with Warren George, Inc. of Jersey City, NJ, and a bathymetricc survey of the offshore area by Buffalo District personnel to establish the top-of-rock profile in the study area (after about the three-foot contour, top-of-rock elevation is the same as the depth of water.) The results of these studies are presented in Appendix A, "Geology, Soils and Construction Materials." In general, the investigation confirmed the results of the boring program completed for the authorized project which indicated that a trough exists in the bedrock that would allow a harbor to be constructed with no rock excavation. This trough runs generally east to west between Cowles Creek and the large pond in the wetland area (Pond "A") and passes through the north half of the existing parking lot. The investigations also indicated that there are two areas where the eight-foot contour (the required depth for the harbor entrance channel) dips in towards shore: (1) opposite Cowles Creek; and (2) opposite the drainage outlet into Lake Erie for the wetland area.

In order to avoid extensive rock excavation, the alternatives formulated for this report were located in areas where the seismic survey indicated low top-of-rock. In addition, the location of the entrance channels for the various alternatives were selected where the eight-foot contour dipped in towards shore.

## Harbor Capacity

The authorized small-boat harbor at Geneva State Park would provide mooring space for approximately 400 boats. Due to the large-scale demand for permanent mooring space in Ashtabula County, however, the possibility of increasing the size of the harbor was discussed with ODNR at the 18 January 1979 workshop meeting (minutes of this meeting are provided as Exhibit F-2 in Appendix F.) At this meeting ODNR stated that they wanted to limit the size of the small-boat harbor at Geneva State Park to 400 boats. Therefore, for this Stage 2, report the alternative harbor layouts investigated will provide sufficient mooring area to accommodate only 400 boats. Most recently by letter dated 17 July 1979 (see Exhibit E-10 of Appendix E), ODNR has indicated a preference for a 300 or 360-boat facility. Appropriate modifications to the 400-boat facility and reevaluation of project economics will be made in Stage 3 based on further discussions with ODNR.

The expected fleet mix for a 400-boat harbor facility at Geneva State Park is shown in Table B6. This fleet mix was generated based on existing boating registration statistics in the State of Ohio modified to account for future competition for berths in the region. A detailed description of this procedure is provided in Appendix D, "Economic Evaluation." The expected fleet mix was used to size the required mooring area and new harbor facilities and to estimate the benefits that would accrue due to construction of a small-boat harbor.

Table B6 - Expected Fleet Mix at Geneva State Park1/

| Type of Craft | Length (feet) | Number of Boats |
|---|---|---|
| Outboards | 16 | 29 |
| Outboards | 16-25 | 12 |
| Inboards | 16-25 | 53 |
| Cruisers | 16-25 | 27 |
| Cruisers | 26-39 | 185 |
| Cruisers | 40-64 | 31 |
| Sailboats | 16 | 5 |
| Sailboats | 16-25 | 5 |
| Auxiliary Sailboats | 16-25 | 6 |
| Auxiliary Sailboats | 26-39 | 37 |
| Auxiliary Sailboats | 40-64 | 6 |
| Transient Boats | - | 4 |
| Total | | 400 |

1/ Does not include the effects of the proposed U. S. Steel plant at Conneaut, OH.

NATIONAL OBJECTIVES

Current Federal policy, as developed by the President's Water Resources Council, requires that the alternative water and related

resource plans be formulated in accordance with the national objectives of National Economic Development (NED) and Environmental Quality (EQ). Therefore, in accordance with the guidance established in Engineering Regulation 1105-2-200, Multiobjective Planning Framework," dated 10 November 1975, this study will be consistent with the planning requirements of the Water Resources Council "Principles and Standards" (P&S) and related policies. In accomplishing the study, equal consideration will be given to the P&S objectives of NED and EQ described below:

National Economic Development (NED) - National Economic Development is achieved by increasing the value of the nation's output of goods and services and improving economic efficiency.

Environmental Quality (EQ) - Environmental Quality is achieved by the management, conservation, preservation, creation, restoration, or improvement of the quality of certain natural and cultural resources and ecological systems.

SPECIFIC PLANNING OBJECTIVES

Specific planning objectives are the National, State, and local water and related land resources management needs (opportunities and problems) specific to a study area that can be addressed to enhance National Economic Development and Environmental Quality. Based on a review of the directives established by the authorizing resolutions for a small-boat harbor and harbor-of-refuge at Geneva State Park, previous reports for the area, statements by individuals in the private sector, input from officials at many levels of government and an analysis of the problems and needs of the study area, as discussed previously, the specific planning objectives for the Geneva-on-the-Lake Small-Boat Harbor project that have been identified are as follows:

a. Appreciable recreational boating demand exists in the area which is presently unfulfilled due to a lack of adequate harbor facilities. Therefore, one objective of this study will be to provide a recreational harbor facility for shallow draft recreational craft which will also enhance the development of the existing State park at Geneva-on-the-Lake.

b. Hazards to small-boat navigation exist due to the absence of a harbor or natural shelter in the 29-mile reach of Lake Erie between Ashtabula Harbor and Fairport Harbor. The need for a harbor-of-refuge facility becomes more critical with each passing year as more and more recreational craft take to Lake Erie. Therefore, the second objective of this study will be to provide a harbor-of-refuge for light-draft recreational craft between these two Federally improved deep-draft harbors.

c. Due to the State Park's location near good recreational fishing areas of Lake Erie, local interests state that appreciable recreational fishing needs exist in the area. Therefore, another objective of this study will be to incorporate, if justified, such facilities in the project as are necessary to aid in meeting the land-based recreational fishing needs of the area. This need could be met, for example, by providing access onto any breakwaters that may be constructed for the small boat harbor.

d. Any development that would modify the existing wetland area within the State Park poses severe environmental concerns. Therefore, one objective of this study will be to minimize or eliminate any adverse environmental impacts resulting from this project on the wetland area. This objective could be met, for example, by relocating the authorized harbor project, relocating the existing wetland area, or increasing the quality of the remaining wetland area if a portion of the wetland area is destroyed.

e. Any development that disrupts existing park facilities poses severe concerns to the State of Ohio. Therefore, one objective of this study will be to minimize or eliminate any adverse impact on exisiting park facilities. This objective could be met, for example, by relocating the authorized harbor project or relocaitng the existing park facilities.

f. The maintenance of national strength and satisfactory levels of living will be achieved by increased national income and productivity. Therefore, one objective of this study will be to maintain or improve the economic status of the area. This objective will be met by constructing a harbor for which the benefits derived from the project exceed the project costs.

g. Previous Corps reports have indicated the need for shoreline protective works to reduce shoreline erosion at Geneva State Park. Therefore, another objective of this study will be to incorporate such facilities as are required to make the harbor project compatible with the existing and future shoreline protective works at the State Park.

CONDITIONS IF NO FEDERAL ACTION TAKEN (WITHOUT PROJECT CONDITIONS)

In any formulation there is always the basic question of "is there a justified need for change." Therefore, the conditions that would exist if no Federal action were taken was investigated for this Stage 2 report. Besides answering the basic question, these conditions will also provide a common basis for comparing alternative plans of improvement as discussed in Section C of the Main Report.

As a result of no action, there would be no recreational small-boat harbor facilities for local craft or a harbor-of-refuge for transient boats at Geneva State Park and vicinity since no other public agency or private developer has indicated that they would be willing or financially able to provide the necessary improvements. Therefore, the existing and future large-scale demand for permanent mooring space and additional launching facilities in the area would not be fulfilled. In addition, the potential for damage to transient boats and loss of lives will continue to be present in the area and will increase in time as more and more boaters take to Lake Erie. The local resort economy will also be thwarted since fewer tourists will be attracted to the area and the required supportive facilities such as motels, restaurants, marine supplies stores, entertainment, etc., will not be required. No development would also not aid in meeting the demand expressed by local interests for additional recreational fishing facilities in the area since the breakwater structures would not be built. In addition, the existing State Park would not realize its full investment value since it would not be used to its full potential due to a lack of boating facilities.

If no Federal action were taken, the existing environment (including the wetland area) would not be disturbed. It is also quite possible that, in the absence of a small-boat harbor, the value of the wetlands would increase as wildlife species, which are sensitive to disturbances by man, infest the area. In addition, there would be no disturbance of the other existing and planned park development or the nearshore littoral processes.

# SECTION C
# FORMULATION OF ALTERNATIVE PLANS

This section of the Stage 2 report provides: a brief review of the alternatives investigated during the survey study; subsequent events that necessitated reformulation of the authorized plan of improvement; the formulation methodology used in this Stage 2 evaluation; and a discussion of the development of alternative plans.

## PLAN FORMULATION RATIONALE

### Alternatives Considered in the Survey Study

The survey study, as reported in House Document 91-402, considered one basic plan of improvement for meeting the recreational boating needs at Geneva-on-the-Lake. This plan, shown on Plate 3 of Appendix I, is described in Section A, preceding. Although minor variations of the recommended plan were considered for the survey report, no other alternative plans were evaluated. The authorized plan would provide a marina capacity for 400 permanent-based boats and a ramp for launching trailer-drawn boats.

### Need for Reformulation of Alternatives (Reformulation Phase I General Design Memorandum)

The need for reformulating the authorized project is discussed in detail in Section A. In summary, post-survey physical changes at the project site (such as construction of a parking lot and expansion of an existing wetland area resulting from the parking lot construction) and legislative and executive actions that emphasize preservation of wetlands and the preservation and enhancement of the natural and human environment, led to the conclusion that reformulation of the authorized project is required. Approval to conduct a Reformulation Phase I General Design Memorandum was provided on 8 February 1978 (See Exhibit B-12 of the Plan of Study).

### Stage 2 Reformulation

The objective of this Stage 2 investigation is to identify the best general plan(s) for satisfying the recreational boating needs at Geneva State Park based on physical constraints, the desires and preferences of local interests for recreational boating, and consistent with sound engineering, economic and environmental principles. In this process, an iterative procedure that provided for increased levels

of refinement in design and critique and evaluation by the principal study participants (i.e. - Corps of Engineers; Ohio Department of Natural Resources; and U.S. Fish and Wildlife Service) was used to narrow the range of alternatives to carry forward. The procedure also allows for review and comments by the general public at informal meetings, workshops and public meetings.

Investigation of other water resources problems and needs, such as other types of recreation, water quality, sedimentation, erosion and/or flooding, is limited to a level of refinement necessary to adequately assess potential impacts of each on recreational boating. Of particular importance at Geneva State Park is shoreline erosion. Section A of the Main Report discusses the Shoreline Erosion Demonstration Project and a Section 103 Shoreline Erosion Study at Geneva State Park.

GENERAL FORMULATION AND EVALUATION CRITERIA

Federal policy on multiobjective planning, derived from both legislative and executive authorities, establishes and defines the national objectives for water resource planning, specifies the range of impacts that must be assessed, and sets forth the conditions and criteria which must be applied when evaluating plans. Plans must be formulated to meet the needs of the area with due regard to benefits and costs, both tangible and intangible, and effects on the ecology and social well-being of the community.

The formulation of a plan, including the screening of alternatives, must of necessity be within the context of an appropriate framework and set of criteria. The planning framework is established in the Water Resource Council's "Principles and Standards for Planning Water and Related Land Resources," which requires the systematic preparation and evaluation of alternative solutions to problems, under the objectives of National Economic Development (NED) and Environmental Quality (EQ). The process also requires that the impacts of a proposed action be measured and the results displayed or accounted for in terms of contributons to four accounts: NED, EQ, Regional Development (RD), and Social Well-Being (SWB). The formulation process must be conducted without bias as to structural and nonstructural measures.

Within the structure of the overall planning framework other more specific criteria relative to general policies, technical engineering, economic principles, social and environmental values and local conditions must be established. These criteria, noted as

"Technical," "Economic" and "Socio-economic and Environmental" are listed as follows:

Technical Criteria

a. Design wave and lake level should be based on the recreational boating season which is assumed to extend from April to November on Lake Erie.

b. A coincident 200-year design frequency, using the 20-year recurrence significant deep water wave height in combination with the ten-year lake level, should be used for design of structures.

c. Overtopping of protective works for the design condition would be permitted to the extent that the residual interior wave shall be limited to a height consistent with safe and efficient operation of the marina facility.

d. Final design of the selected plan will be based on a model study to be performed by the Waterways Experiment Station.

e. A sand bypass system will be incorporated into the project to compensate for down-drift loss of beach-building material caused by the harbor structures.

Economic Criteria

a. Tangible benefits should exceed project economic costs.

b. Each separable unit of improvement or purpose should provide benefits at least equal to its cost unless justifiable on a non-economic basis.

c. Each plan, as ultimately formulated, should provide the maximum net benefits possible within the formulation framework.

d. The costs for alternative plans of development should be based on preliminary layouts, estimates of quantities, and 1979 unit prices.

e. The benefits and costs should be in comparable economic terms to the fullest extent possible.

f. A 50-year economic life and 6-7/8 percent interest rate are used for the economic evaluation.

g. The base case for comparison of alternatives plans is the "do-nothing" (no-action) plan.

Socio-economic and Environmental Criteria

The criteria for socio-economic and environmental consideration in water resource planning are prescribed by the National Environmental Policy Act of 1969 (PL 91-190) and Section 122 of the River and Harbor Act of 1970, (PL 91-611). These criteria prescribe that all significant adverse and beneficial economic, social, and environmental effects of planned developments be considered and evaluated during plan formulation. In addition, Executive Order 11990 dated 24 May 1977 directs that each agency shall provide leadership and take action to minimize the destruction, loss or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands.

<u>Design and Other Considerations for Harbor and Marina Layout</u>

Channels

a. Depth of Entrance Channel

1. All-weather Harbor: 8 feet below Low Water Datum (El. 568.6 on IGLD-1955)

2. Fair-weather Harbor: 6 feet below LWD.

b. Depth of Interior Channels: 6 feet below LWD

c. Channel widths: Minimum width of 100 feet for entrance, and interior channels.

Marina Requirements

a. For Stage 2 preliminary design purposes, it was assumed that approximately 1,000 square feet of surface area would be required per dockage space. This includes the area needed for the maneuvering area and access channels outside the Federal channels.

b. For this analysis it was assumed that the marina should have a 400-slip capacity which is consistent with the Ohio Department of Natural Resources' contemplated recreational boating development at Geneva State Park.

Harbor Location

Locate the harbor entrance and marina to take advantage of areas where bedrock is relatively deep, thereby minimizing expensive rock excavation.

Support Facilities

For Stage 2, assume that two launching ramps and a public landing with service facilities will be provided.

Wave Requirements

a. All-Weather Harbor: For the design wave condition, breakwaters and channels will be designed to limit wave heights to three feet in the entrance channel and 1 foot in the mooring area. Theoretical wave heights will be validated in a model study to be initiated in Stage 3 of the Phase I and completed during preparation of the Phase II General Design Memorandum.

b. Fair-Weather Harbor: Protective works shall be designed to prevent shoaling in the entrance channel and prevent overtopping by waves up to three feet in height.

Slope Protection

a. Vertical Walls - A reinforced concrete "L" wall was assumed for costing purposes.

b. Slopes - Side slopes of 1V:3H were used, and riprap protection would be provided from -6 feet LWD to either +6 or +8 feet LWD.

Spoil Disposal

a. For this study, it was assumed that excavated material would be placed in the undeveloped camping area at the west end of the park.

b. Cost estimates are based on trucking to the disposal site. A sufficient amount of contingency and cost is included in the estimate for landscaping and reseeding the area.

Mitigation

a. Disruption or Loss of Wetlands - There is insufficient environmental data at this time to determine the need for mitigation or the type of mitigation that might be required. Therefore, plans or costs for mitigation are not included in the estimates for this Stage 2 report. Concepts such as a control structure to maintain existing water levels in the wetlands and planting trees between the

marina and wetlands to serve as a sound barrier have been identified as possible methods for mitigation, and will be considered in Stage 3, as appropriate.

Cost-Sharing

a. General Navigation Features - First costs for general navigation features such as breakwaters and entrance and interior access channels will be cost-shared 50 percent Federal and 50 percent non-Federal. Annual maintenance costs and aids to navigation are 100 percent Federal.

b. Recreational Breakwater Fishing - First costs would be shared 50 percent Federal and 50 percent non-Federal, and annual operation and maintenance costs would be 100 percent non-Federal.

c. Support Facilities - Support facilities such as excavation for dockage and access areas, dock construction, construction of service facilities and launching ramps are 100 percent non-Federal. These costs are considered to be self-liquidating, and, therefore, are not included in determination of the economic viability of the plan.

PLANS OF OTHERS

Local interests at Ashtabula Harbor, located 12 miles to the east, are actively pursuing similar small-boat harbor development at that location. The small-boat demand analysis (see Appendix D) performed for this study indicates that the total demand for the area is about 1,290 boats in 1990. With about 800 berthing spaces available at this time, the excess demand in the short-term would be 490 spaces. If the facility at Geneva State Park provides for 400 of these spaces, there would be very little need for other harbor facilities in the area. Buffalo District will work closely with affected local and State officials on this matter in Stage 3.

## DEVELOPMENT OF ALTERNATIVE PLANS (Possible Solutions)

Within the prescribed planning framework and established criteria, possible solutions were identified and will be evaluated in a three-stage iterative process to address the needs of the study area and the overall planning objectives. Each stage includes the four functional planning tasks of problem identification, formulation of alternatives, impact assessment and evaluation. Each stage contains essentially the same sequence of tasks but emphasis shifted as the process proceeded.

This document reports the results of the Stage 2 evaluation. The level of study performed is consistent with the Stage 2 objective of evaluating a broad range of possible solutions and identifying the best general plan (or plans) for satisfying the recreational boating needs at Geneva State Park.

Geneva State Park is a multi-use recreational complex that provides, or will provide, opportunities for picnicking, camping, swimming and recreational boating. The primary water resources need for which a solution is sought under this authority is provision of facilities for recreational navigation. As possible solutions to addressing this primary need, an array of ten structural solutions and one nonstructural solution, in addition to the "no-action" option, was initially identified. The first iteration of possible solutions is discussed in the following section. Through the process of assessment and evaluation of these initial concepts in terms of their contributions to the planning objectives and accounts, five options (including no-action) were selected for further assessment and evaluation. These five intermediate alternatives are discussed in Section D, "Assessment and Evaluation of Preliminary Plans."

### Initial Iteration of Alternatives

As the first step, an orientation workshop was held in Columbus, OH, on 15 December 1977 (See Exhibit F-1 of Appendix F) to discuss potential problems with providing small-boat facilities at Geneva State Park and to obtain input on possible alternatives to be considered. Representatives of Buffalo District, U.S. Fish and Wildlife Service and the Ohio Department of Natural Resources attended. Constraints to project development, such as high bedrock at the site, an existing wetland, and existing and planned park facilities (parking lot, bathhouse, swimming beaches, etc.) were identified and discussed. The Ohio Department of Natural Resources indicated that an alternate site to Geneva State Park would not be acceptable. Therefore, no further consideration was given to evaluating harbor sites outside Geneva State Park.

For this initial iteration, two different levels of harbor intent were considered. These levels are:

a. An all-weather harbor and harbor-of-refuge with sufficient capacity to provide for 400 slips.

b. A fair-weather harbor that would provide for about 100 slips.

Based on the input from the 15 December 1977 workshop and physical constraints at the Park, conceptual layouts for eight structural alternatives were prepared.

These conceptual alternatives are presented in Appendix B1, and along with other considered alternatives, are identified below.

Alternative 1 - All-Weather Harbor at Cowles Creek (400 slips)
Alternative 2 - All-Weather Offshore/Onshore Harbor (400 slips)
Alternative 3 - All-Weather Wetland/Parking Lot Harbor (400 slips)
Alternative 4 - All-Weather Wetland Harbor (400 slips)
Alternative 5 - Fair-Weather Harbor at Cowles Creek (100 slips)
Alternative 6 - Fair-Weather Wetland/Parking Lot Harbor (100 slips)
Alternative 7 - All-Weather Offshore Harbor (400 slips and 2,500 feet of breakwater)
Alternative 8 - All-Weather Offshore Harbor (400 slips and 2,200 feet of breakwater)
Alternative 9 - Do Nothing (no action)
Alternative 10- Non-structural Dry Storage Plan
Alternative 11- Alternate Site to Geneva State Park
Alternative 12- All-Weather Entrance with Dry Storage at Geneva State Park

## Critique of First Iteration of Alternatives

A meeting was held with the Ohio Department of Natural Resources (ODNR) on 18 January 1979 (See Exhibit F-2 of Appendix F for minutes) to discuss the conceptual alternatives that had been prepared (Alternatives 1 through 8) and to obtain ODNR's views on which harbor alternatives are acceptable for further study. Based on consideration of ODNR's position and because they would not satisfy any of the projected recreational boating demand for permanently-based craft in the area nor would they meet the planning objective for a harbor-of-refuge, the fair-weather harbors (Alternatives 5 and 6) were eliminated from further consideration. Alternatives 7 and 8 were also rejected because they would have a much higher cost than other alternative all-weather plans. The non-structural dry storage plan (Alternative 10) was rejected since it would not meet the planning objective for a harbor-of-refuge. This consideration is critical

on Lake Erie because its shallow depth and long fetch quickly produce rough seas when subjected to sudden, relatively moderate winds from the west-southwest through east-northeast. Alternative 11 was also rejected because ODNR desires to further develop Geneva State Park as a multi-use recreational facility to include small-boat recreation and has no interest in purchasing additional lands in the area for this purpose. Alternative 12 was rejected by ODNR in subsequent discussions because of significant operations problems experienced at an existing dry-storage facility elsewhere in the State. Since ODNR will not support dry-storage, no further consideration will be given to Alternative 12. Although there were certain reservations regarding the viability of some of the remaining alternatives, it was decided to further evaluate structural Alternatives 1 through 4 and to carry forward the "Do-Nothing" alternative.

# SECTION D
# ASSESSMENT AND EVALUATION OF PRELIMINARY PLANS

Preliminary evaluation of possible conceptual solutions indicated that nonstructural measures would not meet the objective of providing safe opportunities for small-boat recreation in the study area. Similarly, a facility that would provide a fair-weather harbor is unacceptable because it would not meet the basic need for a refuge harbor for either locally based or transient craft in this relatively long reach of shoreline where few such facilities exist. In view of the planning objectives, and a cursury evaluation of accounts, and the related technical, economic, and socioeconomic criteria, an all-weather artificial harbor located onshore or onshore/offshore was considered to have the greatest promise for providing a solution to the recreational boating need in the study area.

This section provides a summary of the engineering design, economic evaluation and environmental assessment of four alternative structural plans that an initial screening of a wide range of possible solutions indicated had the greatest potential for meeting the planning objective of providing all-weather small-boat facilities at Geneva State Park. These four alternatives are:

- Alternative Plan 1 - All-Weather Harbor at Cowles Creek (400 slips)
- Alternative Plan 2 - All-Weather Offshore/Onshore Harbor (400 slips)
- Alternative Plan 3 - All-Weather Wetland/Parking Lot Harbor (400 slips)
- Alternative Plan 4 - All-Weather Wetland Harbor (400 slips)

In addition, the basis of comparison for the above structural plans is:

- Alternative Plan 5 - No Action (Do Nothing) Plan

Appendices A through D to this report provide details of the engineering and economic analyses associated with the four structural alternatives for which preliminary designs were prepared. These appendices are:

- Appendix A - Geology, Soils and Construction Materials
- Appendix B - Design and Coastal Processes
- Appendix C - Cost Estimate for Alternatives 1 through 4
- Appendix D - Economic Evaluation

## STANDARD FEATURES OF ALTERNATIVE PLANS

### Sand Bypass System

Predominent littoral drift at Geneva State Park is from west to east. To prevent starvation of the down-drift shoreline, a 6-inch sand bypass pipe would be placed beneath the entrance channel for all alternative plans. Sand that accretes to the west of the harbor structure would periodically be pumped to the east for down-drift nourishment.

### Entrance Channels

For this preliminary design, the entrance channel for all alternatives would be 8 feet below Low Water Datum (LWD=568.6 IGLD-1955) and 100 feet wide. These dimensions were selected to provide safe navigation for the projected fleet and to provide for two-way boat traffic at the entrance. A workshop will be held with boating interests in Stage 3 to discuss this aspect of the project, and refinement in the dimensions will be made, as appropriate. Protective works would be provided to limit the wave height in the entrance channel to 3 feet for the design condition.

### Interior Channels

The interior access channels would be excavated to the 6-foot depth (below Low Water Datum) and would be a minimum of 100 feet in width. Wave heights would be limited to 1 foot.

### Mooring Areas and Service Facilities

As previously stated, the mooring areas were located to minimize costly rock excavation. For comparative cost estimating purposes, a standard depth of 6 feet below LWD was used for all mooring areas although this depth may be conservative particularly for any portion of the mooring area restricted to small craft with a static draft of less than 2 feet. In addition, using LWD as the reference plane may be conservative since the mean level of Lake Erie is nearly 2 feet above LWD and the monthly mean stage for the height of the boating season varies between one-half foot and 1 foot above LWD 95 percent of the time. Therefore, the depths of all channels and mooring areas will be reevaluated in Stage 3 to take into account fluctuating lake levels and boat characteristics to insure a reasonable but not overly conservative design.

Sideslopes of 1V:3H were used at the periphery of the mooring areas, where practical, to attenuate wave reflection and surging.

Sideslopes would be riprapped, where necessary, to prevent erosion and sloughing of the banks and to further dissipate internal wave energy.

A public dock with appurtenant public service facilities such as fuel and pump-out stations, available to all on an equal basis, is incorporated into each alternative plan.

Although the costs for the marina and appurtenant features of the marina are considered to be self-liquidating and, therefore, are not included in the evaluation of economic efficiency of the project, preliminary estimates of quantities and costs were prepared and are presented herein. These costs will be used by the sponsoring agency in its decision on plan selection.

Pertinent engineering, economic, environmental, and related data for each alternative plan follow.

## ALTERNATIVE PLAN 1 - COWLES CREEK

### Description of Plan 1

Plan 1 would provide an all-weather harbor with a 400-slip capacity located inland near the mouth of Cowles Creek. In selecting Cowles Creek, the concept was to locate the marina outside of the wetland area. The Cowles Creek area provides the only apparent location in the park of sufficient size to accommodate a 400-boat marina without excessive rock and/or earth excavation. The layout and project features for Plan 1 are shown on Plate 12 of Appendix I. The harbor entrance would be located immediately offshore from Cowles Creek to take advantage of the rock trough, thus, minimizing the amount of rock excavation. The entrance would be protected by a modified arrowhead rubblemound breakwater system. Both arms of the arrowhead would be shore-connected to prevent shoaling of the navigation channel, to prevent adverse wave conditions in the harbor, and to provide access for fishing from the west breakwater. A short interior breakwater would be required to further reduce the transmitted wave into the mooring area to 1 foot. In addition, a 6-inch sand bypass pipe would be placed between the arms of the arrowhead to prevent starvation of the down-drift shoreline. Design computations for these features of Plan 1 are presented in Appendix B.

The location of the marina facilities were selected to minimize rock excavation. Consequently, a 2.5-acre site at the mouth of Cowles Creek, with a capacity for 100 slips and a 7.4-acre site in the existing parking lot (300-slip capacity), were identified for the mooring basins. The interior channel to the mooring basins would be 100 feet wide to the west and 130 feet wide to the east because of probable heavy traffic from the north and south basins and the launching ramps. A vertical reinforced concrete wall would be constructed along the north and west limits of the interior channel

to minimize loss of land in the vicinity of the existing bathhouse and to provide dockage for craft being serviced. An existing footbridge near the outlet of Cowles Creek would be relocated to the south to provide access between Beaches A and B.

An eight-foot deep sediment trap with a capacity of 1,500 to 2,000-cubic yards would be excavated in Cowles Creek immediately upstream of the northerly mooring area. The purpose of this trap is to collect Cowles Creek sediment, thereby, reducing maintenance dredging within the interior channel and mooring basin.

Cost Estimate for Plan 1

The detailed cost estimate for Plan 1 is presented in Table C2 of Appendix C. The breakdown of the cost for lands and damages is shown in Table C1 of Appendix C, and the annual charges are summarized in Table C6.

Tables D-1 and D-2, following, summarize the estimated project costs and annual charges and provide a breakdown of the Federal and non-Federal share of these costs for Plan 1. From these tabulations, it is seen that the total project cost is $4,749,000 (Table D-1), the total investment cost, including interest during construction is $5,033,300 (Table D-2), and total annual charges are $403,300. Table D-2 also includes cost allocation by project purpose.

Economic Evaluation of Plan 1

The detailed discussion of the projected recreational boating demand, fleet mix, and recreational boating benefits for Geneva State Park is presented in Appendix D. Paragraphs D32 through D34 of Appendix D provide an introductory discussion of breakwater fishing potential at Geneva State Park. The Columbus, OH, office of the U. S. Fish and Wildlife Service has been requested to evaluate the breakwater fishing benefits for the proposed project, and the results should be available early in Stage 3 for incorporation into the Draft Phase I.

Since ODNR, the local sponsor, prefers a facility with 400 berths at Geneva State Park (apparently reduced to 300 or 360 slips based on ODNR's 17 July 1979 letter included as Exhibit E-10 of Appendix E), the economic evaluation for all alternatives herein is based on a 400-boat marina, although benefits for a 600-boat marina are also included in Appendix D. In addition, Scenario 1, (does not consider the effects of construction of a large U. S. Steel steel mill at Conneaut, OH), is used for the analysis herein. From Table D30 of Appendix D, the average annual direct navigation benefits for all four alternative plans is $553,900. Using $10,000 average annual

Table D-1 - Estimate of Total Project Cost for Alternative Plan 1 and Federal and Non-Federal Share (May 1979 Price Levels)

| Item | Amount | Total |
|---|---|---|
| | $ | $ |
| TOTAL PROJECT COSTS: | | |
| 1. Relocations | 12,000 1/ | |
| 2. Channels | 1,465,000 | |
| 3. Breakwaters | 1,442,000 | |
| 4. Recreational Facilities | 104,000 2/ | |
| 5. Aids to Navigation | 24,000 3/ | |
| 6. Lands and Damages | 614,000 | |
| 7. Footbridge and Sidewalk | 121,000 3/ | |
| 8. Engineering and Design | 738,000 4/ | |
| 9. Supervision and Administration | 229,000 | |
| Total Project Cost | | 4,749,000 5/ |
| FEDERAL SHARE: | | |
| 50 Percent of Items 1, 2, 3, 4, 8, and 9 | 1,995,000 | |
| Aids to Navigation (U. S. Coast Guard) | 24,000 | |
| Total Federal Share of Project Cost | | 2,019,000 5/ |
| NON-FEDERAL SHARE: | | |
| Cash Contribution (50 Percent of Items 1, 2, 3, 4, 8, and 9) | 1,995,000 | |
| Lands and Damages | 614,000 | |
| Footbridge and Sidewalks | 121,000 | |
| Total Non-Federal Share of Project Cost | | 2,730,000 5/ 6/ |

1/ For removing an existing footbridge across Cowles Creek.

2/ To provide walkway and handrail on west breakwater for breakwater fishing.

3/ Cost includes necessary Engineering and Design and Supervision and Administration.

4/ Includes $124,000 for hydraulic model study.

5/ Cost estimate does not include costs for mitigation of adverse environmental impacts that may be required for Plan 1. Costs for mitigation will be included in the Stage 3 documents, as appropriate.

6/ Does not include costs for self-liquidating features of the project, such as dredging of mooring areas and construction of docks, launching ramps and public service facilities. The estimated non-Federal cost for these self-liquidating features is $4,150,000 (May 1979 price levels.)

Table D-2 - Estimated Investment Cost and Annual Charges for Alternative Plan 1 (May 1979 Price Levels)1/

| Item | Navigation | Recreation | Total |
|---|---|---|---|
| | $ | $ | $ |
| TOTAL INVESTMENT FOR THE PROJECT: | | | |
| Total Project Cost, Excluding Lands | 4,031,000 | 104,000 | 4,135,000 |
| Interest During Construction | 277,100 | 7,200 | 284,300 |
| Lands and Damages | 614,000 | - | 614,000 |
| Total Investment, Including Lands | 4,922,100 | 111,200 | 5,033,300 |
| ANNUAL CHARGES FOR THE PROJECT: | | | |
| Interest | 338,400 | 7,600 | 346,000 |
| Amortization | 12,600 | 300 | 12,900 |
| Maintenance | 39,400 | 5,000 | 44,400 |
| Total Annual Charges | 390,400 | 12,900 | 403,300 |
| FEDERAL SHARE: | | | |
| Total Investment Cost | | | |
| Total Project Cost | 1,967,000 | 52,000 | 2,019,000 |
| Interest During Construction | 135,200 | 3,600 | 138,800 |
| Total Investment | 2,102,200 | 55,600 | 2,157,800 |
| Annual Charges | | | |
| Interest | 144,500 | 3,800 | 148,300 |
| Amortization | 5,400 | 100 | 5,500 |
| Maintenance | 39,400 2/ | - | 39,400 |
| Total Annual Charges | 189,300 | 3,900 | 193,200 |
| NON-FEDERAL SHARE: | | | |
| Total Investment Cost, Including Lands | | | |
| Total Project Cost, Excluding Lands | 2,064,000 | 52,000 | 2,116,000 |
| Interest During Construction | 141,900 | 3,600 | 145,500 |
| Lands and Damages | 614,000 | - | 614,000 |
| Total Investment, Including Lands | 2,819,900 3/ | 55,600 | 2,875,500 |
| Annual Charges | | | |
| Interest | 193,900 | 3,800 | 197,700 |
| Amortization | 7,200 | 200 | 7,400 |
| Maintenance | - | 5,000 4/ | 5,000 |
| Total Annual Charges | 201,100 | 9,000 | 210,100 |

1/ 6-7/8 percent interest rate, 50-year life (i = .06875, amort. = .00257). Does not include cost for mitigation of environmental impacts.
2/ 100 percent Federal for general navigation.
3/ Excludes $4.15 million for self-liquidating costs.
4/ 100 percent non-Federal.

harbor-of-refuge benefits, the total average annual navigation benefits for the four alternative plans are $563,900 as shown in Table D31 of Appendix D.

Table D-3, following, summarizes the annual charges, annual benefits, net benefits, and benefit-to-cost ratio for Plan 1. Net navigation benefits are $173,500 and the benefit/cost ratio for navigation is 1.44. Even with the recreational fishing benefits excluded, the B/C ratio remains favorable at 1.39.

Environmental Features/Assessment of Plan 1

Creation of a small-boat harbor at this site would disturb or alter the water circulation patterns of Cowles Creek and the lake shoreline environment at Geneva-on-the-Lake, OH. The accretion and erosion mechanisms in the immediate vicinity would be altered, although this may not be a significant problem if a sand bypass system is utilized to nourish downdrift-starved areas. Sand accreted (or placed, if a bypass system is used) could be held more effectively at Beach A (north of the bathhouse and west of Cowles Creek.)

A boat harbor at this location would sever the beach east of Cowles Creek (Beach B) from the existing bathhouse. The existing footbridge, just south of the mouth of Cowles Creek would be removed and a new walkway and footbridge would have to be constructed upstream to provide access to the bathhouse. This would require greater walking distance to the bathhouse for those people using the beach east of Cowles Creek and the surrounding parkland. This walkway would cross a road leading to the boat launch ramps, creating a potentially dangerous situation. The greater walking distance also would, undoubtedly, be an inconvenience to many people utilizing the park facilities. Not only would the boat harbor sever the beach from the existing bathhouse, it would also locate boating activity between Beach A and Beach B creating a potential hazard to bathers. Approximately one-half of the parking lot would also be destroyed, thus, this alternative would considerably disrupt existing park facilities.

Water quality in the vicinity of Beach B could be adversely affected by degraded water from the boat harbor. Oil, gas, and sewage spills are likely to occur in the harbor, resulting in impaired water quality to beach users. Depending on the circulation patterns in the areas during summer months, this could be a potential health hazard.

The aquatic ecosystem of Cowles Creek could be adversely affected by implementation of such a project. However, the importance of Cowles Creek as a habitat for fish spawning, waterfowl, and shorebirds has

Table D-3 - Summary of Benefits and Costs for Plan 1

| | Navigation | Recreational Fishing | Total Project |
|---|---|---|---|
| | $ | $ | $ |
| Average Annual Benefit | 563,900 | Not Available 1/ | 563,900 1/ |
| Average Annual Cost | | | |
| Federal | 189,300 | 3,900 | 193,200 |
| Non-Federal | 201,100 | 9,000 | 210,100 |
| Total | 390,400 | 12,900 | 403,300 |
| Net Benefits | 173,500 | Unavailable | 160,600 1/ |
| Benefit/Cost Ratio | 1.44 | Unavailable | 1.39 1/ |

1/ Excludes recreational breakwater fishing benefits which are being prepared by U. S. Fish and Wildlife Service and will be included in the Draft Phase I.

not been determined. Studies will be completed in the Fall of 1979 to supply biological information for impact assessment and evaluation.

This alternative would require that a section of shoreline approximately 500 feet in length be committed for the development of this project. Substantial amounts of offshore aquatic habitat would be lost upon implementation of this alternative. A total of about 2.9 acres would be disturbed by dredging and construction of rubblemound breakwaters. The surface area of the offshore rock revetment structures would provide approximately 0.6 acres of colonizable benthic habitat, however, as well as increased fishing access. The approximately 10.3 acres of terrestrial area excavated to produce mooring facilities would create aquatic habitat. Wetland, with palustrine persistent emergent vegetation, approximately 0.9 acres, would be lost by construction of this alternative. An additional 24 acres of wetland would be vulnerable to secondary impacts resulting from increased boat traffic. The loss of wetland at Geneva-on-the-Lake could markedly decrease the fish and wildlife value of the area. The irreversible alteration of the aesthetic characteristics of the shoreline and the irretrievable commitment of materials, labor, and machinery to the construction and maintenance of the project area are also considered to be significant commitments of resources.

A 400-slip small-boat harbor in the park at Geneva-on-the-Lake would help to satisfy demand for such facilities in the area, as well as help to increase utilization of the park and its existing facilities.

In general, this alternative would position the harbor entrance in a north-northeast direction to allow sufficient depth for boaters to gain entry into the harbor. This could pose a navigation problem to many boaters trying to enter the harbor during storms and other inclement weather conditions. As recreational craft position to enter the harbor, wind generated waves from the northwest and southwest would strike boats broadside causing navigation difficulties. This problem could be very serious during sudden storm activity as boaters seek to gain entrance into the harbor. Winds from this direction occur with a greater frequency than any other direction. Boaters would also be required to turn immediately after entering the entrance channel which would present difficulties to sailboaters. Relocating the entrance channel would require extensive rock excavation and an increase in breakwater length which would greatly increase the cost of this alternative.

## Mitigation Needs for Plan 1

The needs for mitigation of adverse environmental effects was not established in Stage 2 and, therefore, specific mitigation plans were not identified for any of the alternative plans. The results of the U. S. Fish and Wildlife Service evaluation of the need for mitigation will be completed early in Stage 3, and mitigation plans will be prepared for the Draft Phase I, as appropriate.

## Implementation of Plan 1

Of the four structural alternatives presented herein, Plan 1 is preferred by the U. S. Fish and Wildlife Service. Although it has a favorable B/C ratio and appears to be the most compatible with the existing environmental setting, Plan 1 would seriously effect other recreational activities in the view of ODNR because it severs convenient access between Beaches A and B and isolates the bathhouse. Plan 1 is strongly opposed by ODNR, thus, having little chance for implementation.

ALTERNATIVE PLAN 2 - OFFSHORE/ONSHORE HARBOR

Description of Plan 2

Plan 2 would provide an all-weather harbor contiguous to the existing wetland/pond area and west of the bathhouse as shown on Plate 13 of Appendix I. This location was selected to limit encroachment into the wetlands and existing parking lot.

The harbor entrance would be located at a depression in the rock profile, thus, minimizing costly rock excavation. The L-shaped west breakwater, with a crest elevation of +14 (LWD) to reduce the interior design wave to 1 foot and a total length of 1,300 feet, would provide an offshore mooring area of about 7.6 acres and berthing for 300 pleasure boats. Excavation of a portion of the offshore mooring basin would be required to provide the 6-foot depth used in this study. The west breakwater would not be shore-connected to permit circulation through the mooring area. A short sandtrap breakwater would be constructed to minimize transport of littoral material into the mooring area and navigation channel. The intake for a 6-inch sand bypass pipe would be located near this trap. Access for fishing from the west breakwater would be provided by a footbridge. The shoreline within the offshore mooring area would be shaped and riprapped to prevent erosion from wave action created by recreational craft. For planning purposes, it was assumed that the public dock would be located offshore in an area relatively convenient to the navigation channel. The east breakwater would be 600 feet long and shore-connected to provide needed wave protection and access for breakwater fishing. In addition, a 6-inch sand bypass pipe would be placed between the east and west breakwaters to prevent starvation of the down-drift shoreline.

Because the offshore berthing area would be a considerable distance from the existing parking lot (about 3,000 feet by a rather circuitous route around the wetlands), it appears that additional parking facilities in closer proximity to the offshore area would be required to realize the full recreational navigation benefits for Plan 2. One possible solution would be to provide a parking area near the west breakwater. This matter has been discussed with ODNR and will be resolved in Stage 3 if Plan 2 is selected for further, more detailed study.

The interior channel, which would provide access to the onshore mooring area, was located to limit encroachment into the wetlands and existing parking area. The westerly side would be riprapped to prevent erosion from wash created by passing craft. An L-shaped mooring area of about 2.5 acres would provide berthage for 100 boats. As with Plan 1, a vertical concrete wall was used to prevent encroachment into the parking area. Launching ramps at the southerly limit of the project would be convenient to the existing parking area.

Cost Estimate for Plan 2

Table C3 of Appendix C is the detailed cost estimate for Plan 2. Table D4, following, summarizes the project costs and shows the apportionment of costs to project interests. The breakdown of annual charges by project purpose is presented in Table D-5. The project cost for Plan 2 is $4,346,000 (Table D-4); the total investment cost, including interest during construction, is $4,631,100 (Table D-5); and the annual charges, including maintenance, are $374,700.

Table D-4 - Estimate of Total Project Cost for Alternative Plan 2
(May 1979 Price Levels)

| Item | Amount | Total |
|---|---|---|
| | $ | $ |
| TOTAL PROJECT COSTS: | | |
| 1. Channels | 880,000 | |
| 2. Breakwaters | 2,023,000 | |
| 3. Recreational Facilities | 225,000 1/ | |
| 4. Aids to Navigation | 48,000 2/ | |
| 5. Lands and Damages | 198,000 | |
| 6. Engineering and Design | 738,000 3/ | |
| 7. Supervision and Administration | 234,000 | |
| Total Project Cost | | 4,346,000 4/ |
| FEDERAL SHARE: | | |
| 50 Percent of Items 1, 2, 3, 6, and 7 | 2,050,000 | |
| Aids to Navigation ( U. S. Coast Guard) | 48,000 | |
| Total Federal Share of Project Costs | | 2,098,000 4/ |
| NON-FEDERAL SHARE: | | |
| Cash Contribution (50 Percent of Items 1, 2, 3, 6 and 7 | 2,050,000 | |
| Lands and Damages | 198,000 | |
| Total Non-Federal Share of Project Costs | | 2,248,000 4/ 5/ |

1/ Footbridge, walkways, and handrails for breakwater fishing.

2/ Cost includes necessary E&D and S&A.

3/ Includes $124,000 for hydraulic model study.

4/ Does not include costs for mitigation of adverse environmental impacts that may be required for Plan 2. Costs for mitigation, if required, will be included in the Draft Phase I.

5/ Does not include non-Federal cost for self-liquidating features of the project which is estimated at $3.58 million (May 1979 price levels.)

Table D-5 - Estimated Investment Cost and Annual Charges for Alternative Plan 2 (May 1979 Price Levels)1/

| Item | Navigation | Recreation | Total |
|---|---|---|---|
| | $ | $ | $ |
| TOTAL INVESTMENT FOR THE PROJECT: | | | |
| Total Project Cost, Excluding Lands | 3,923,000 | 225,000 | 4,148,000 |
| Interest During Construction | 269,700 | 15,400 | 285,100 |
| Lands and Damages | 198,000 | - | 198,000 |
| Total Investment, Including Lands | 4,390,700 | 240,400 | 4,631,100 |
| ANNUAL CHARGES FOR THE PROJECT: | | | |
| Interest | 301,900 | 16,500 | 318,400 |
| Amortization | 11,300 | 600 | 11,900 |
| Maintenance | 36,200 | 8,200 | 44,400 |
| Total Annual Charges | 349,400 | 25,300 | 374,700 |
| FEDERAL SHARE: | | | |
| Total Investment Cost | | | |
| Total Project Cost | 1,985,500 | 112,500 | 2,098,000 |
| Interest During Construction | 136,500 | 7,700 | 144,200 |
| Total Investment | 2,122,000 | 120,200 | 2,242,200 |
| Annual Charges | | | |
| Interest | 145,900 | 8,300 | 154,200 |
| Amortization | 5,500 | 300 | 5,800 |
| Maintenance | 36,200 2/ | - | 36,200 |
| Total Annual Charges | 187,600 | 8,600 | 196,200 |
| NON-FEDERAL SHARE: | | | |
| Total Investment Cost, Including Lands | | | |
| Total Project Cost, Excluding Lands | 1,937,500 | 112,500 | 2,050,000 |
| Interest During Construction | 133,200 | 7,700 | 140,900 |
| Lands and Damages | 198,000 | - | 198,000 |
| Total Investment, Including Lands | 2,268,700 3/ | 120,200 | 2,388,900 |
| Annual Charges | | | |
| Interest | 156,000 | 8,200 | 164,200 |
| Amortization | 5,800 | 300 | 6,100 |
| Maintenance | - | 8,200 4/ | 8,200 |
| Total Annual Charges | 161,800 | 16,700 | 178,500 |

1/ 6-7/8 percent interest rate, 50-year life (i = .06875, amort. = .00257). Does not include cost for mitigation of environmental impacts.
2/ 100 percent Federal for general navigation.
3/ Excludes $3.58 million for self-liquidating costs.
4/ 100 percent non-Federal.

## Economic Evaluation of Plan 2

As for Plan 1 previously discussed, the total average annual navigation benefits for Plan 2 are $563,900 for the proposed 400-slip facility. A summary of annual charges, annual benefits, net benefits, and benefit-to-cost ratio by project purpose is presented in Table D-6, below. Net benefits for recreational navigation are $214,500 and the B/C ratio is 1.61. The net benefits for the total project, excluding as yet undetermined fishing benefits, would be $189,200, and the B/C ratio is 1.50.

Table D-6 - Summary of Benefits and Costs for Plan 2

| | Navigation | Recreational Fishing | Total Project |
|---|---|---|---|
| | $ | | |
| Average Annual Benefit | 563,900 | Not Available 1/ | 563,900 1/ |
| Average Annual Cost | | | |
| Federal | 187,600 | 8,600 | 196,200 |
| Non-Federal | 161,800 | 16,700 | 178,500 |
| Total | 349,400 | 25,300 | 374,700 1/ |
| Net Benefits | 214,500 | Unavailable | 189,200 |
| Benefit/Cost Ratio | 1.61 | Unavailable | 1.50 |

1/ Excludes recreational breakwater fishing benefits which are being prepared by U. S. Fish and Wildlife Service for inclusion into the Draft Phase I.

## Environmental Features/Assessment of Plan 2

Construction of a small-boat harbor at this site would place the facility in a sheltered position with respect to storm and wave activity. The accretion and erosion mechanisms in the immediate vicinity would be altered, however, a sand bypass system would be utilized to nourish downdrift-starved areas. Approximately 2.6 acres of wetland would be irreversibly lost, however, the U. S. Fish and Wildlife Service has indicated that mitigation would likely be feasible. Their final determination will be submitted to the Corps upon completion of field studies in the Fall of 1979.

Creation of a small-craft facility at this location could alter the water levels and current patterns in the wetland area. The vegetation characteristic of the wetland would probably be altered or changed at a greater rate than natural successional processes would allow for. These changes could alter existing habitat types and influence the diversity of animals presently utilizing the area. Additionally, the proximity of the harbor may preclude use of the marsh by those waterfowl that are least tolerant of disturbance.

This alternative would require that a section of shoreline approximately 1,200 feet in length be committed for the development of this project. Approximately 16 acres of offshore aquatic habitat would be disturbed by dredging and construction of rubblemound breakwaters. The surface area of the offshore rock revetment structures would provide approximately 1.2 acres of colonizable benthic habitat, however, as well as increased fishing access. The approximately 5.3 acres of terrestrial area excavated to produce mooring facilities would create aquatic habitat. Approximately 2.6 acres of wetland would be lost by construction of this alternative. The irreversible alteration of the aesthetic characteristics of the shoreline and the irretrievable commitment of materials, labor, and machinery to the construction and maintenance of the project area are also considered to be significant commitments of resources.

The loss of approximately 2.6 acres of wetlands is undoubtedly the major irreversible loss associated with this alternative. In addition, about 22.4 acres of wetland would receive direct disturbance by the noise, dust, and water craft emissions characteristic of most boat harbors.

Under this alternative, all existing park facilities, beaches, and parking areas would remain intact. A 400-slip small-boat harbor in the park at Geneva-on-the-Lake would help to satisfy demand for such facilities in the area, as well as help to increase utilization of the park and its existing facilities.

## Mitigation Needs for Plan 2

The need for mitigation of adverse environmental impacts has not been determined to present. Further studies by the U. S. Fish and Wildlife will evaluate this need, and mitigative measures will be investigated in Stage 3 and reported in the Draft Phase I, as appropriate.

## Implementation of Plan 2

Plan 2 is economically justified and appears to be environmentally viable. It is one of the two alternative plans recommended for further consideration by the U. S. Fish and Wildlife Service. Although ODNR has not identified Plan 2 for further consideration, the Buffalo District considers it to be a reasonable compromise between the environmental and functional concerns at Geneva State Park. It is, therefore, concluded that Plan 2 is probably implementable and should be considered further in Stage 3 of this Phase I study.

ALTERNATIVE PLAN 3 - WETLAND/PARKING LOT HARBOR

Description of Plan 3

Plan 3 would provide an onshore, all-weather harbor with berthing for 400 boats on lands about equally distributed between the wetlands and parking lot. The proposed plan is shown on Plate 14 of Appendix I.

The harbor entrance would be located to take advantage of the existing rock trough and would be protected by an arrowhead breakwater system. Because of the trough, the breakwaters would be relatively short, aggregating 1,050 feet. Both arms would be shore-connected, thus, providing access for breakwater fishing. Since the west breakwater would be remote from existing parking and other park facilities, an access road to the breakwater and nearby parking would be required to realize the full fishing benefit. This aspect will be pursued in depth in Stage 3 if Plan 3 is selected for further study. A sand bypass system would be incorporated into the project for down-drift nourishment.

The entrance channel would be oriented in a south-southeasterly direction to bypass the mouth of the intermittant stream with the objective of minimizing the impact on the wetland area. A short, low jetty would be required on the west side of the channel at the lake-land interface to provide a stable channel at this location, and to prevent encroachment into the intermittant stream a short distance to the west. The remainder of the connecting channel would be riprapped to prevent erosion of the sideslopes from prop-wash. The interior channel would service a large basin of about 7.9 acres with berths for 340 boats to the south, and a small mooring area of 1.4 acres with 60 berths to the north. The perimeter of the marina complex would be protected by riprap and vertical concrete walls. The public dock would be located south of the existing bathhouse and the launching ramps at the northeast corner of the marina, convenient to existing parking.

Cost Estimate for Plan 3

The detailed cost estimate for Plan 3 is presented in Table C-4 of Appendix C. Table D-7, following, summarizes the project costs, including apportionment of costs to project interests. Allocation of costs to project purposes and annual charges are shown in Table D-8. Principal costs for Plan 3 are for constructing the channels and breakwaters, about equally distributed, and the total project cost, including lands, is $3,666,000 (Table D-7.) The total investment cost including lands and interest during construction (two-year construction period) is $3,884,100, and total annual charges are $310,700 (Table D-8).

Table D-7 - Estimate of Total Project Cost for Alternative Plan 3
(May 1979 Price Levels)

| Item | Amount | Total |
|---|---|---|
| | $ | $ |
| TOTAL PROJECT COSTS: | | |
| 1. Channels | 1,124,000 | |
| 2. Breakwaters | 1,021,000 | |
| 3. Recreational Facilities | 94,000 1/ | |
| 4. Aids to Navigation | 24,000 2/ | |
| 5. Lands and Damages | 492,000 | |
| 6. Engineering and Design | 730,000 3/ | |
| 7. Supervision and Administration | 181,000 | |
| Total Project Cost | | 3,666,000 4/ |
| FEDERAL SHARE: | | |
| 50 Percent of Items 1, 2, 3, 6, and 7 | 1,575,000 | |
| Aids to Navigation ( U. S. Coast Guard) | 24,000 | |
| Total Federal Share of Project Costs | | 1,599,000 4/ |
| NON-FEDERAL SHARE: | | |
| Cash Contribution (50 Percent of Items 1, 2, 3, 6, and 7 | 1,575,000 | |
| Lands and Damages | 492,000 | |
| Total Non-Federal Share of Project Costs | | 2,067,000 4/ 5/ |

1/ Walkways and handrails for breakwater fishing.

2/ Cost includes necessary E&D and S&A.

3/ Includes $124,000 for hydraulic model study.

4/ Does not include costs for mitigation of adverse environmental impacts that may be required for Plan 3. Mitigation will be evaluated in Stage 3, as appropriate.

5/ Does not include non-Federal cost for self-liquidating features of the project which is estimated at $4.13 million (May 1979 price levels.)

Table D-8 - Estimated Investment Cost and Annual Charges for Alternative Plan 3 (May 1979 Price Levels)1/

| Item | Navigation | Recreation | Total |
|---|---|---|---|
| | $ | $ | $ |
| TOTAL INVESTMENT FOR THE PROJECT: | | | |
| Total Project Cost, Excluding Lands | 3,080,000 | 94,000 | 3,174,000 |
| Interest During Construction | 211,700 | 6,400 | 218,100 |
| Lands and Damages | 492,000 | - | 492,000 |
| Total Investment, Including Lands | 3,783,700 | 100,400 | 3,884,100 |
| ANNUAL CHARGES FOR THE PROJECT: | | | |
| Interest | 260,100 | 6,900 | 267,000 |
| Amortization | 9,700 | 300 | 10,000 |
| Maintenance | 29,200 | 4,500 | 33,700 |
| Total Annual Charges | 299,000 | 11,700 | 310,700 |
| FEDERAL SHARE: | | | |
| Total Investment Cost | | | |
| Total Project Cost | 1,552,000 | 47,000 | 1,599,000 |
| Interest During Construction | 106,700 | 3,200 | 109,900 |
| Total Investment | 1,658,700 | 50,200 | 1,708,900 |
| Annual Charges | | | |
| Interest | 114,000 | 3,500 | 117,500 |
| Amortization | 4,300 | 100 | 4,400 |
| Maintenance | 29,200 2/ | - | 29,200 |
| Total Annual Charges | 147,500 | 3,600 | 151,100 |
| NON-FEDERAL SHARE: | | | |
| Total Investment Cost, Including Lands | | | |
| Total Project Cost, Excluding Lands | 1,528,000 | 47,000 | 1,575,000 |
| Interest During Construction | 105,000 | 3,200 | 108,200 |
| Lands and Damages | 492,000 | - | 492,000 |
| Total Investment, Including Lands | 2,125,000 3/ | 50,200 | 2,175,200 |
| Annual Charges | | | |
| Interest | 146,000 | 3,500 | 149,500 |
| Amortization | 5,500 | 100 | 5,600 |
| Maintenance | - | 4,500 4/ | 4,500 |
| Total Annual Charges | 151,500 | 8,100 | 159,600 |

1/ 6-7/8 percent interest rate, 50-year life (i = .06875, amort. = .00257). Does not include cost for mitigation of environmental impacts.
2/ 100 percent Federal for general navigation.
3/ Excludes $4.13 million for self-liquidating costs.
4/ 100 percent non-Federal.

## Economic Evaluation of Plan 3

As for Plans 1 and 2, the total average annual navigation benefits for Plan 3 are $563,900. Recreational breakwater fishing benefits are yet to be defined, and will be included in the Draft Phase I. Annual benefits, annual charges, net benefits, and the benefit-to-cost ratio by project purposes are presented in Table D-9, below. Net benefits for navigation are estimated at $264,900 and the benefit-to-cost ratio is 1.89. Excluding recreational breakwater fishing benefits, the net benefits and B/C ratio for the total project are, $253,200 and 1.82, respectively. As with the other plans, the values stated do not include costs for mitigation of adverse environmental effects, which could be considerable for Plan 3.

Table D-9 - Summary of Benefits and Costs for Plan 3

| | Navigation | Recreational Fishing | Total Project |
|---|---|---|---|
| | $ | | |
| Average Annual Benefit | 563,900 | Not Available 1/ | 563,900 1/ |
| Average Annual Cost 2/ | | | |
| Federal | 147,500 | 3,600 | 151,100 |
| Non-Federal | 151,500 | 8,100 | 159,600 |
| Total | 299,000 | 11,700 | 310,700 |
| Net Benefits | 264,900 | Unavailable | 253,200 |
| Benefit/Cost Ratio | 1.89 | Unavailable | 1.82 |

1/ Excludes recreational breakwater fishing benefits which are being prepared by U. S. Fish and Wildlife Service for inclusion into the Draft Phase I.

2/ Does not include costs for mitigation of adverse environmental impacts which may, or may not, be required for Plan 3.

Environmental Features/Assessment of Plan 3

Construction of a small-boat harbor at this site would place the facility in a sheltered position with respect to storm and wave activity. The accretion and erosion mechanisms in the immediate vicinity would be altered, however, a sand bypass system would be utilized to nourish downdrift-starved areas. The plan would require that a section of shoreline, approximately 800 feet in length, be committed for the development of this project. In addition, approximately 2.6 acres of offshore aquatic habitat would be disturbed by dredging and construction of rubblemound breakwaters. The surface area of the offshore rock revetment structures would provide approximately 0.6 acres of colonizable benthic habitat, however, as well as increased fishing access. The approximately 12.5 acres of terrestrial area excavated to produce mooring facilities would create aquatic habitat. Approximately five acres of wetland would be lost by construction of this alternative. The irreversible alteration of aesthetic characteristics of the shoreline and the irretrievable commitment of materials, labor, and machinery to the construction and maintenance of the project area are also considered to be significant commitments of resources.

Approximately five acres of wetland would be irreversibly lost by implementation of this alternative. Development of this facility could cause further degradation to the 20 remaining acres and associated habitat types as they would receive direct disturbance by the noise, dust, and water craft emissions characteristic of most boat harbors. The impact of this alternative on the wetland area is basically the same as Alternative 2.

Although this alternative would destroy a portion of the parking lot (approximately one-fourth) and would reduce access to the bathhouse, its impact would not be as severe as Alternative 1. Alternative 3 would not interfere with access between Beach A and Beach B. A 400-slip small-boat harbor in the park at Geneva-on-the-Lake would help to satisfy demand for such facilities in the area as well as help to increase utilization of the park and its existing facilities.

Mitigation Needs for Plan 3

The need for mitigation of adverse environmental impacts has not been determined to present. However, since the layout presented would displace about 5 acres of wetland, construction in kind would

undoubtedly be required. Further studies by the U. S. Fish and Wildlife Service will evaluate this need, and mitigative measures will be investigated in Stage 3 and reported in the draft Phase I, as appropriate.

Implementation of Plan 3

Based on 17 July 1979 correspondence from ODNR (Exhibit E-10 of Appendix E), a modified Plan 3 is the apparent preference of that agency. In the accompanying drawings, ODNR has shown a reduction in the desired harbor capacity from 400 slips to either 300 or 360 slips. This being the case, it is probable that the associated construction could be oriented to reduce the amount of wetland displaced. Although the U. S. Fish and Wildlife Service has indicated opposition to Plan 3 (Exhibits E-8 and E-9 of Appendix E), it is the District's position that Plan 3 is a reasonable compromise and probably could be implemented, particularly with the modification in capacity suggested by ODNR.

ALTERNATIVE PLAN 4 - WETLANDS HARBOR

Description of Plan 4

Plan 4 would provide an onshore all-weather harbor with berthing for 400 boats in the easterly portion of the wetlands area adjacent to the existing parking lot. The proposed plan is shown on Plate 15 of Appendix I.

The breakwaters and entrance channel would be similar to those for Plan 3 except that the orientation of these features would be shifted to provide a more nearly north-south alignment to reduce the length of the west breakwater. A short spending beach would be constructed to the east of the entrance channel to prevent transmittal of the attenuated design wave in the entrance into the mooring area. A sand bypass system would be incorporated into the project for down-drift nourishment.

The mooring area would aggregate about 9.6 acres primarily in the wetlands. The periphery would be protected against erosion from prop-wash by riprap or vertical concrete walls. The public service facilities and boat launching ramps would be located at the east end of the marina convenient to existing parking.

Cost Estimate for Plan 4

The detailed cost estimate for Plan 4 is presented in Table C-5 of Appendix C. Table D-10, following, summarizes the project costs, including apportionment to project interests. Annual charges, allocated by project purpose, are shown in Table D-11. The total project cost for Plan 4 is estimated at $2,959,000, the total investment $3,153,200, and annual charges would be $256,800.

Table D-10 - Estimate of Total Project Cost for Alternative Plan 4
(May 1979 Price Levels)

| Item | Amount | Total |
|---|---|---|
| | $ | $ |
| TOTAL PROJECT COSTS: | | |
| 1. Channels | 751,000 | |
| 2. Breakwaters | 1,081,000 | |
| 3. Recreational Facilities | 81,000 1/ | |
| 4. Aids to Navigation | 24,000 2/ | |
| 5. Lands and Damages | 135,000 | |
| 6. Engineering and Design | 726,000 3/ | |
| 7. Supervision and Administration | 161,000 | |
| Total Project Cost | | 2,959,000 4/ |
| FEDERAL SHARE: | | |
| 50 Percent of Items 1, 2, 3, 6, and 7 | 1,400,000 | |
| Aids to Navigation ( U. S. Coast Guard) | 24,000 | |
| Total Federal Share of Project Costs | | 1,424,000 4/ |
| NON-FEDERAL SHARE: | | |
| Cash Contribution (50 Percent of Items 1, 2, 3, 6, and 7 | 1,400,000 | |
| Lands and Damages | 135,000 | |
| Total Non-Federal Share of Project Costs | | 1,535,000 4/ 5/ |

1/ Walkways and handrails for breakwater fishing.

2/ Cost includes necessary E&D and S&A.

3/ Includes $124,000 for hydraulic model study.

4/ Does not include costs for mitigation of adverse environmental impacts that may be required for Plan 4. Mitigation will be evaluated in Stage 3, as appropriate.

5/ Does not include non-Federal cost for self-liquidating features of the project which is estimated at $3.78 million (May 1979 price levels.)

Table D-11 - Estimated Investment Cost and Annual Charges for Alternative Plan 4 (May 1979 Price Levels)1/

| Item | Navigation | Recreation | Total |
|---|---|---|---|
| | $ | $ | $ |
| TOTAL INVESTMENT FOR THE PROJECT: | | | |
| Total Project Cost, Excluding Lands | 2,743,000 | 81,000 | 2,824,000 |
| Interest During Construction | 188,600 | 5,600 | 194,200 |
| Lands and Damages | 135,000 | - | 135,000 |
| Total Investment, Including Lands | 3,066,600 | 86,600 | 3,153,200 |
| ANNUAL CHARGES FOR THE PROJECT: | | | |
| Interest | 210,800 | 6,000 | 216,800 |
| Amortization | 7,900 | 200 | 8,100 |
| Maintenance | 28,000 | 3,900 | 31,900 |
| Total Annual Charges | 246,700 | 10,100 | 256,800 |
| FEDERAL SHARE: | | | |
| Total Investment Cost | | | |
| Total Project Cost | 1,383,500 | 40,500 | 1,424,000 |
| Interest During Construction | 95,100 | 2,800 | 97,900 |
| Total Investment | 1,478,600 | 43,300 | 1,521,900 |
| Annual Charges | | | |
| Interest | 101,600 | 3,000 | 104,600 |
| Amortization | 3,800 | 100 | 3,900 |
| Maintenance | 28,000 2/ | - | 28,000 |
| Total Annual Charges | 133,400 | 3,100 | 136,500 |
| NON-FEDERAL SHARE: | | | |
| Total Investment Cost, Including Lands | | | |
| Total Project Cost, Excluding Lands | 1,359,500 | 40,500 | 1,400,000 |
| Interest During Construction | 93,500 | 2,800 | 96,300 |
| Lands and Damages | 135,000 | - | 135,000 |
| Total Investment, Including Lands | 1,588,000 3/ | 43,300 | 1,631,300 |
| Annual Charges | | | |
| Interest | 109,200 | 3,000 | 112,200 |
| Amortization | 4,100 | 100 | 4,200 |
| Maintenance | - | 3,900 4/ | 3,900 |
| Total Annual Charges | 113,300 | 7,000 | 120,300 |

1/ 6-7/8 percent interest rate, 50-year life (i = .06875, amort. = .00257). Does not include cost for mitigation of environmental impacts.
2/ 100 percent Federal for general navigation.
3/ Excludes $3.78 million for self-liquidating costs.
4/ 100 percent non-Federal.

Economic Evaluation of Plan 4

The total average annual navigation benefits are $563,900 as defined in Appendix D. Recreational breakwater fishing benefits will be determined for inclusion into the Draft Phase I. From Table D-12, below, the net benefits for navigation are $317,200 and the benefit-to-cost ratio is 2.29 (excludes cost for mitigation which could be considerable for Plan 4.)

Table D-12 - Summary of Benefits and Costs for Plan 4

| | Navigation | Recreational Fishing | Total Project |
|---|---|---|---|
| | $ | | |
| Average Annual Benefit | 563,900 | Not Available 1/ | 563,900 1/ |
| Average Annual Costs 2/ | | | |
| Federal | 133,400 | 3,100 | 136,500 |
| Non-Federal | 113,300 | 7,000 | 120,300 |
| Total | 246,700 | 10,100 | 256,800 1/ |
| Net Benefits | 317,200 | Unavailable | 307,100 |
| Benefit/Cost Ratio | 2.29 | Unavailable | 2.19 |

1/ Excludes recreational breakwater fishing benefits which are being prepared by U. S. Fish and Wildlife Service for inclusion into the Draft Phase I.

2/ Does not include costs for mitigation of adverse environmental impacts which may, or may not, be required for Plan 4.

Environmental Features/Assessments of Plan 4

Construction of a small-boat harbor at this site would place the facility in a sheltered position with respect to storm and wave activity. The accretion and erosion mechanisms in the immediate vicinity would be altered, however, a sand bypass system would be utilized to nourish downdrift-starved areas.

Alternative 4 would directly destroy approximately 17.6 acres of wetland. Indirect impacts to the remaining 7.4 acres would be more serious than those associated with any of the other alternatives. The value of the entire wetland would be destroyed by the disturbances of noise, dust, and water craft emissions characteristic of most boat harbors. Although this is the least costly alternative, the amount that would have to be spent on wetland mitigation would be very high, therefore, possibly making this plan more costly than any of the other alternatives. Water levels in the swamp could be severly lowered. Additionally, the proximity of the harbor to the larger borrow pit and to the swamp would almost certainly reduce their use by various species of wildlife.

This alternative would require that a section of shoreline approximately 600 feet in length be committed for the development of this project. Approximately 3.9 acres of offshore aquatic habitat would be disturbed by dredging and construction of rubblemound breakwaters. The surface area of the offshore rock revetment structures would provide approximately 0.5 acres of colonizable benthic habitat, however, as well as increased fishing access. The approximately 12.2 acres of terrestrial area excavated to produce mooring facilities would create aquatic habitat. The irreversible alternation of the aesthetic characteristics of the shoreline and the irretrievable commitment of materials, labor, and machinery to the construction and maintenance of the project area are also considered to be significant commitments of resources.

This alternative leaves all existing park facilities, including beaches and parking areas, intact. A 400-slip small-boat harbor in the park at Geneva-on-the-Lake would help to satisfy demand for such facilities in the area as well as help to increase utilization of the park and its existing facilities.

Mitigation Needs for Plan 4

Plan 4 would directly destroy nearly 18 acres of wetland, and indirectly impact on the remaining 7 acres. As a minimum, replacement in kind by man-made construction would be required. Until the

fish and wildlife survey is completed by U. S. Fish and Wildlife Service this fall, the need for other mitigation of adverse environmental impacts will not be known.

## Implementation of Plan 4

Plan 4 is opposed by U. S. Fish and Wildlife Service. In addition, the Buffalo District has concluded that since there are practical alternatives to Plan 4 which would occupy most of the wetland, Plan 4 is not a viable plan and should not be implemented.

## ALTERNATIVE PLAN 5 - NO ACTION

The "no action" or "do nothing" plan represents the base condition for evaluation of the four structural plans previously described. This option, although not favored by local project sponsors and the recreational boating community, avoids both the monetary investments and potential adverse impacts associated with structural improvements. The plan would not meet any of the needs of boaters or recreational fishermen in the area. It would not provide a harbor-of-refuge for pleasure craft along a relatively long, unprotected reach of Lake Erie shoreline that presently has no such facilities. Problems stated earlier in this report would remain unchanged. The "no action" plan would not meet the planning objective to provide a safe, all-weather small boat facility in the study area.

## SUMMARY EVALUATION OF IMPACTS DURING CONSTRUCTION - PLANS 1-5

Social Effects: Noise - Construction noises would occur which could be disturbing to visitors to the park if any of the alternatives, except the "no action" alternative, is carried out. Probably the most disturbing noises would accompany the excavation of land, because this activity involves intense, persistent physical impact between machinery and dense materials to be broken up and moved (ashphalt and soil.) Also, this excavation is to be performed on areas directly adjacent to fairly well-used park facilities where visitor population is likely to be high. The plans which include the most excavation of land are Alternatives 3 and 4 (both roughly 15 acres), while Alternative 1 is intermediate in this respect (roughly 13 acres of land planned to be excavated.) Alternative 2, which includes an offshore harbor, requires the least excavation of land (roughly eight acres) and, thus, probably would be the least disturbing of the implementable plans as a noise source during construction. Noise would also be generated by breakwater construction affecting visitors to the park. It is anticipated that this would be a fairly continuous motor noise as water and land-based cranes and barges manipulate stone material. This noise effect is expected to be about equal for all the plans, and would affect mainly visitors at beach areas nearest the activity.

Social Impacts: Displacement of People - No residential development exists in the area where construction would occur, so no major displacement will occur. Beach visitors may choose to avoid bathing sites nearest construction activity and, thereby, be displaced to equivalent nearby sites.

Social Impacts: Aesthetics - Climatic conditions of the Lake Erie coast dictate that major construction be accomplished during the

period of heaviest use of the park and beaches. Offshore construction activities would present an obstruction to the natural view of the lake and in some ways detract from the scenic beauty of the shore. Conversely, some visitors to the area might derive pleasure and interest from viewing construction work in progress.

<u>Social Impacts: Community Cohesion</u> - None of the alternatives are planned to occur in a community, thus, there would be no effect on community cohesion.

<u>Social Impacts: Community Growth</u> - No effect upon community growth is anticipated from any construction alternative or the "no action" plan.

<u>Economic Effects: Tax Revenues and Property Values</u> - No effect upon tax revenues and property values is expected from either construction of a project or the "no action" plan, because an action would be relatively short-term, of low magnitude, and situated on land owned by the State of Ohio.

<u>Economic Effects: Public Facilities and Services</u> - Local business establishments such as restaurants, service and repair shops, motels, and retail stores may be expected to benefit from the presence of construction workers involved in carrying out all plans except the "no action" plan. This effect would be slight because of the small size of the anticipated work crews (less than 30 persons.) Similarly, demand for public services, in the form of police, rescue, and medical services will not rise appreciably due to the presence of the workers. Other public services, such as refuse collection, sewage treatment, water supply, and public utilities would certainly be sufficient to accommodate any foreseeable immediate project-related population increases.

<u>Economic Effects: Employment/Labor Force</u> - The input of capital into a project would result in a temporary increase in employment and the labor force during construction. These impacts would be of short duration, as construction is expected to occur two seasons only. The following would be required for each alternative:

| | |
|---|---|
| Alternative 1 | 25 persons |
| Alternative 2 | 25 persons |
| Alternative 3 | 20 persons |
| Alternative 4 | 15 persons |
| No Action (5) | 0 persons |

<u>Economic Effects: Business and Industrial Activity</u> - The construction of any of the plans, except the "no action" plan, is a business activity of an industrial nature. Assuming that this positive effect

is proportional to the cost of a given alternative, they may be assessed in relative terms, as follows:

| Alternative | Total First Cost - Government Estimate |
|---|---|
| | $ |
| 1 | 4,135,000 |
| 2 | 4,148,000 |
| 3 | 3,174,000 |
| 4 | 2,824,000 |
| No Action (5) | 0 |

The above cost estimates do not include the self-liquidating cost associated with each alternative for the mooring area, launching ramps, and public service facilities currently estimated at: (1) $4,150,000 for Alternative 1; (2) $3,580,000 for Alternative 2; (3) $4,130,000 for Alternative 3; and (4) $3,780,000 for Alternative 4. These self-liquidating facilities are the responsibility of the non-Federal sponsor, ODNR.

Environmental Effects: Air Quality - Air quality in the proposed project area would be temporarily affected by dust, noise, odors, and vehicle emissions from the operation of construction equipment, in the instance of any of the plans except for the "no action" plan. The construction Contractor would be required to control such emissions and effects where practical.

Environmental Effects: Water Quality - Some short-term reversible impacts on water quality would occur during construction of any of the implementable plans for construction of a small-boat harbor at Geneva-on-the-Lake. There would probably be some unavoidable spilling of fuels, oil, and grease into the water from the operation of both land-based and marine construction and earth-moving equipment. Considerable amounts of turbidity would be unavoidably created during breakwater construction and channel dredging. This would be a high magnitude, short-term impact and should disappear soon after construction and/or dredging is completed.

Environmental Effects: Cultural Resources - The project will not affect any cultural resources currently listed or eligible for the National Register of Historic Places (NRHP). However, as the area has never been systematically surveyed, the project may affect, as yet undiscovered, cultural resources which may be potentially eligible for the NRHP. Therefore, a Cultural Resources Reconnaissance will be conducted early in Stage 3 to insure that all historical sites are identified prior to plan implementation.

Environmental Effects: Natural Resources - Certain aspects of all the implementable plans, except the "no action" plan, would require

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the commitment of natural resources in the form of construction materials and energy expended during the construction process. These include: (1) breakwater stone, which would be quarried from a nearby quarry that can provide the proper materials at the most economical cost, in the following quantities:

| Alternative | Tons of Stone |
|---|---|
| 1 | 37,572 |
| 2 | 50,680 |
| 3 | 24,640 |
| 4 | 22,480 |

The above figures comprise both bedding stone and armor stone; (2) steel, which would be used to construct a 6-inch diameter sand bypass pipeline for all alternatives; (3) oil and gasoline, which would be used in all phases of construction by vehicles and machinery.

Environmental Effects: Man-made Resources - Two of the four alternatives require excavation of a currently existing car-parking area to create boat mooring space. The total area presently developed for car parking at the park is roughly 16 acres. Alternative 1 would commit about 9 acres of this area for mooring facilities, while Alternative 3 would use roughly 5 acres of this previously developed area.

Environmental Effects: Ecosystems - Some destructive, largely irreversible impacts would occur to wildlife populations and their habitat as a result of construction of implementable projects. The most significant habitat, in terms of uniqueness, productivity, and value to wildlife, is a diverse undeveloped 25-acre area of mainly wetland sites located west of the existing parking facilities. Direct destruction or severe disturbance to portions of the wetland area would occur in the event that any of several alternatives are implemented, as follows:

| Alternative | Acres of Wetland Impacted |
|---|---|
| 1 | 0 |
| 2 | 2.6 |
| 3 | 5.0 |
| 4 | 17.6 |

The nature and distribution of plant and animal habitats in this area is a key factor in the richness and diversity of life there. Loss of wetland areas and swamp forests is a major contemporary environmental

problem. Executive Order 11990 (24 May 1977) dictates avoidance of new construction located in wetlands unless there is no practical alternative, and that all practical measures are taken to minimize harm. Due to potential destruction of wetlands, Alternative 4 is environmentally unacceptable. Alternatives 2 and 3 impact the wetland areas as illustrated in the table above, and while Alternative 1 does not affect the wetland areas, it would impact significantly upon the mouth of Cowles Creek. The biological resources associated with Cowles Creek have not been evaluated. Field studies of this site are being carried out by the U. S. Fish and Wildlife Service; the data obtained through these investigations are not yet available. Due to the lack of biological information about the area, the magnitude of the potential harm of each of the alternatives cannot be accurately assessed at this time.

Excavation of the land area designated to become a boat-mooring area would result in the production of spoil material in the following amounts: Alternative 1, 124,000 cubic yards; Alternative 2, 77,440 cubic yards; Alternative 3, 146,000 cubic yards; Alternative 4, 144,000 cubic yards. The material would consist of asphalt overburden and soil. Present plans for disposal of this material are to spread it over a portion of the designated camping area of the park, and to stabilize the material by seeding the area to produce grass cover. This suggested disposal site has not been evaluated in environmental terms.

## SUMMARY ASSESSMENT OF IMPACTS FOR FUTURE CONDITIONS - PLANS 1-5

This section of environmental assessment will attempt to identify impacts that would occur to Geneva State Park in the future after a small-boat harbor is constructed. The output of the proposed plans is to benefit small-boat navigation and provide pier-fishing opportunities.

Social Effects: Noise and Aesthetics - The existence of a small-boat harbor at Geneva State Park would detract in some ways from its scenic beauty. Views along the shoreline would be obstructed by breakwaters and, in several of the alternatives, natural areas would be replaced by essentially lifeless structures and facilities. The increased attendance at the park, facilitated mainly by increased development for the use of motorized contrivances, would result in an increased level of noise and commercial activity there, which is precisely what a growing number of Americans are seeking to avoid during their leisure time. This would detract from the quality of the recreation experience of some members of several groups of the non-boating public, including those who engage in the following activities at the park: camping, swimming, fishing, hiking, picnicing, and nature study.

Economic Effects: Business and Industrial Activity, Employment, Tax Revenues, and Property Values - One of the primary justifications for the proposal of a small-boat harbor project at this site is based on the belief that national strength and satisfactory levels of living will be achieved by increased national income and productivity. An objective of studies connected with the proposed harbor is to maintain or improve the economic status of the area. Presently the State park is underutilized, and a small-boat harbor here would increase attendance. Concomitant with that increase would be an increase in tourist-related business activity in the area, and industrial activity related to boating. This would include increases in employment locally in temporary lodging, restaurant, and retail store establishments.

Commercial properties have a market value which is largely dependent upon their suitability for successful business activity. In the case of areas of high tourism, an influx of visitors determines the amount of income generated on a tract of land and, in turn, largely determines both property values and tax revenues (property and income taxes).

Economic Effects: Displacement of Farms - No farms or farmland exists in the area of the proposed project. Therefore, no farms or farmlands will be affected by any of the implementable plans for Geneva-on-the-Lake.

# SECTION E
# COMPARISON OF PLANS

Initially, a total of 12 plans were considered as possible solutions for meeting the small boat navigation needs at Geneva State Park. Of these, seven were dropped from further consideration in the initial iteration primarily because they did not satisfy the objective of providing an all-weather harbor at the site. Of the five remaining alternatives that were considered for in-depth study, four are structural plans that would provide an all-weather facility with berthing for 400 boats, and the fifth is the "no-action," or basis-of-comparison, plan. Engineering, economic, and environmental aspects of these five plans were discussed in Section D.

## COMPARISON OF PLANS

A summary matrix of the comparative costs, benefits, and economic efficiency for each of the five alternative plans considered is presented in Table E1 below. This is followed by Table E2 that provides an abbreviated "summary of effects" for the five plans based on available information.

Table E1 - Economic Comparison of Alternative Plans 1 Through 5
(May 1979 Price Levels)

| Item | Plan 1 Cowles Creek Harbor | Plan 2 Offshore-Onshore Harbor | Plan 3 Wetland/Parking Lot Harbor | Plan 4 Wetlands Harbor | Plan 5 No Action |
|---|---|---|---|---|---|
| | $ | $ | $ | $ | |
| Total Project Investment[1] | | | | | |
| Federal | 2,157,800 | 2,242,200 | 1,708,900 | 1,521,900 | - |
| Non-Federal | 2,875,500 | 2,388,900 | 2,175,200 | 1,631,300 | - |
| Total | 5,033,300 | 4,631,100 | 3,884,100 | 3,153,200 | - |
| Self-Liquidating Costs[2] | | | | | |
| Non-Federal | 4,150,000 | 3,580,000 | 4,130,000 | 3,780,000 | - |
| Annual Charges | | | | | |
| Federal | 193,200 | 196,200 | 151,100 | 136,500 | - |
| Non-Federal | 210,100 | 178,500 | 159,600 | 120,300 | - |
| Total | 403,300 | 374,700 | 310,700 | 256,800 | - |
| Annual Benefits[3] | 563,900 | 563,900 | 563,900 | 563,900 | - |
| Net Benefits[3] | 160,600 | 189,200 | 253,200 | 307,100 | - |
| Benefit/Cost Ratio[3] | 1.39 | 1.50 | 1.82 | 2.19 | - |

1/ Includes cost of lands and damages and costs for recreational fishing facilities. Does not include cost for mitigation of adverse environmental impacts which may, or may not, be required for Plans 1-4. The need for mitigation will be determined in Stage 3.

2/ Includes estimated costs for excavating mooring areas; docks for 400 berths, public services facilities and launching ramps. Since these costs are considered self-liquidating, they are not included as part of the total project investment in determining the economic efficiency.

3/ Does not include the recreational breakwater fishing benefits which are not available at this time.

Table E2 - Summary of Effects for Alternative Plans 1 Through 5

| | Alternatives | | | | |
|---|---|---|---|---|---|
| | Plan 1 Cowles Creek Harbor | Plan 2 Offshore-Onshore Harbor | Plan 3 Wetlands/Parking Lot Harbor | Plan 4 Wetlands Harbor | Plan 5 No Action |
| | (Figures are average annual equivalent values in $1,000 except where noted) | | | | |
| A. Plan Description | 400-berth all-weather facility at Cowles Creek. Provides fishing from west breakwater. | 400-berth all-weather facility with 300 berths offshore and 100 berths onshore at wetlands-parking lot interface. Provides for breakwater fishing. | 400-berth all-weather onshore facility about equally divided between wetlands and parking lot. Provides for breakwater fishing. | 400-berth all-weather facility occupying about 16 acres of wetland. Provides for breakwater fishing. | Do nothing |
| B. Significant Impacts | | | | | |
| 1. National Economic Development | | | | | |
| a. Beneficial Impacts | | | | | |
| (1) Recreational Navigation | $ 563.9 | $ 563.9 | $ 563.9 | $ 563.9 | None |
| (2) Recreational Fishing | To be determined. | To be determined. | To be determined. | To be determined. | None |
| b. Adverse Impacts | | | | | |
| (1) Project Investment Cost 1/ | $5,033. | $4,631. | $3,884. | $3,153. | None |
| (2) Self-liquidating Cost 2/ | 4,150. | 3,580. | 4,130. | 3,780. | None |
| (3) Annual Charges | 403.3 | 374.7 | 310.7 | 256.8 | None |
| (4) Net Benefits 3/ | 160.6 | 189.2 | 253.2 | 307.1 | None |
| (5) B/C Ratio 3/ | 1.39 | 1.50 | 1.82 | 2.19 | |
| 2. Environmental Quality | | | | | |
| a. Beneficial Impacts | | | | | |
| (1) Aquatic habitat created (Excavated areas in the entrance channel and berthing area) | 10.3 acres | 5.3 acres | 12.5 acres | 12.2 acres | None |
| (2) Colonizable benthic habitat created. (Surface area of breakwater system below average lake level.) | 0.6 acres | 1.2 acres | 0.6 acres | 0.5 acres | None |

Table E2 - Summary of Effects for Alternative Plans 1 Through 5 (Cont'd)

| | Alternatives | | | | |
|---|---|---|---|---|---|
| | Plan 1 | Plan 2 | Plan 3 | Plan 4 | Plan 5 |
| | Cowles Creek Harbor | Offshore-Onshore Harbor | Wetlands/Parking Lot Harbor | Wetlands Harbor | No Action |
| b. Adverse Impacts | | | | | |
| (1) Terrestrial habitat destroyed (area of new aquatic habitat plus periphery) | 12.8 acres | 8.1 acres | 15.1 acres | 14.9 acres | None |
| (2) Aquatic habitat disrupted (twice the area occupied by the breakwaters and entrance channel) | 2.9 acres | 5.4 acres | 2.6 acres | 3.9 acres | None |
| (3) Wetlands disrupted (wetland area occupied by the mooring areas and peripheral areas subject to disruption) | 0.9 acres | 2.6 acres | 5.0 acres | 17.6 acres | None |
| 3. <u>Social Well-Being</u> | | | | | |
| a. Beneficial Impacts | | | | | |
| (1) Recreational, educational and cultural opportunities. | Increased recreation from boating and fishing. | Increased recreation from boating and fishing | Increased recreation from boating and fishing | Increased recreation from boating and fishing | None |
| (2) Enhancement of health, safety, and community well-being. | Significant increase in safety from harbor-of-refuge. | Significant increase in safety from harbor-of-refuge. | Significant increase in safety from harbor-of-refuge. | Significant increase in safety from harbor-of-refuge. | None |
| (3) Public and agency acceptability. | Acceptable to and preferred by USF&WLS who recommends this plan for further consideration. They also are of the opinion that Plan 1 appears to involve the least direct and indirect impacts upon the wetlands and would probably involve the lowest | Qualified acceptability by USF&WLS subject to change contingent upon results of completion of four-seasons study. ODNR has not indicated any position on Plan 2. | Unacceptable to USF&WLS because it impacts on the northeast portion of the wetlands and should be dropped from further consideration because there are other alternatives less damaging to the wetlands. | Unacceptable to USF&WLS because it damages or destroys most of the wetlands. Preferred by State of Ohio because it is the least costly (excluding mitigation which probably would increase the cost above Plan 1) and least disruptive to other park | Unacceptable to the State of Ohio and boating public. |

Table E2 - Summary of Effects for Alternative Plans 1 Through 5 (Cont'd)

| | Alternatives | | | | |
|---|---|---|---|---|---|
| | Plan 1 Cowles Creek Harbor | Plan 2 Offshore-Onshore Harbor | Plan 3 Wetlands/Parking Lot Harbor | Plan 4 Wetlands Harbor | Plan 5 No Action |
| | cost for mitigation of environmental impacts. Unacceptable to State of Ohio primarily because it severs convenient access between two recreation beaches and high project and self-liquidating costs.<br><br>Unacceptable to ODNR because it severs Beaches A and B and isolates the bathhouse. | | Preferred by ODNR. By 17 July 1979 letter, ODNR has indicated that the small-boat facility should be reduced to 300 or 360 slips. | facilities. Unacceptable to Buffalo District because there are "practical" alternatives to Plan 4 which would destroy the wetland. | |
| b. Adverse Impacts<br>(1) Degaded recreational, educational, and cultural opportunities. | *Some.* Severs convenient access between two recreational beaches. | Possible limited degradation of such activities as birdwatching, etc. due to boating activities nearby. | Similar to Plan 2. | Probable significant degradation in birdwatching opportunities, etc. due to construction and operation of boating facilities in the wetlands. | None |
| (2) Deterioration in quality of life, health, and safety. | Temporary air, water, and noise pollution during construction. Noise pollution throughout project life. Potential hazard to swimmers in close proximity to pleasure craft. | Temporary air, water, and noise pollution during construction. Noise pollution throughout project life. | Same as Plan 2 | Same as Plan 2 | No harbor of-refuge for pleasure craft. |

Table E2 - Summary of Effects for Alternative Plans 1 Through 5 (Cont'd)

| | Alternatives | | | | |
|---|---|---|---|---|---|
| | Plan 1 Cowles Creek Harbor | Plan 2 Offshore-Onshore Harbor | Plan 3 Wetlands/Parking Lot Harbor | Plan 4 Wetlands Harbor | Plan 5 No Action |
| (3) Injurious displacement of people and community disruption | None | None | None | None | None |
| 4. <u>Regional Development</u> a. Beneficial Impacts (1) Value of increased income. | Increased income to individual and local businesses | Same as Plan 1 | Same as Plan 1 | Same as Plan 1 | None |
| (2) Quality of increased employment. | Some increase in local and regional employment. | Same as Plan 1 | Same as Plan 1 | Same as Plan 1 | None |

1/ Includes cost of lands and damages and costs for recreational fishing facilities. Does not include cost for mitigation of adverse environmental impacts which may, or may not, be required for Plans 1-4. The need for mitigation will be determined in Stage 3.

2/ Includes estimated costs for excavating mooring areas; docks for 400 berths, public services facilities and launcing ramps. Since these costs are considered self-liquidating, they are not included as part of the total project investment in determining the economic efficiency.

3/ Does not include the recreational breakwater fishing benefits which are not available at this time.

## TRADE-OFF ANALYSIS

Four of the five plans considered for in-depth study are structural plans that would provide an all-weather harbor with berthing for 400 boats and comparable launching facilities for trailer-drawn boats. Each of these structural alternatives would also provide breakwater fishing opportunities. The fifth alternative is the "no action," or do-nothing alternative which would enhance neither recreational boating or fishing opportunities in the project area.

### Trade-off Analysis of "No-Action" vs Structural Alternatives

As previously stated, the no-action plan would not meet any of the regional and local demand for recreational boating and land-based fishing. It would require no monetary investment, preclude the potential for conflict with other park activities and facilities such as swimming beaches and the bathhouse, and eliminate the probable need for mitigation of adverse environmental impacts and project induced shoreline erosion. The trade-offs for the four structural alternatives would be the converse of those for the no-action alternative.

### Trade-Offs for the Four Structural Alternatives

Each of the four structural alternatives would provide an all-weather harbor for 400 boats, comparable boat-launching and service facilities, and a harbor-of-refuge for transient craft. The space available for breakwater fishing varies for the four alternatives dependent upon location and configuration of the breakwaters. The available lengths vary from a minimum of 550 feet for Plan 1; 570 feet for Plan 4; 740 feet for Plan 3; to a maximum of 1,660 feet for Plan 2.

In devising the four structural plans, primary considerations were project costs, potential adverse environmental impacts and adverse effects on existing and proposed park facilities. From Table E1, preceeding, the apparent least costly alternative is Plan 4 at $3.15 million and the most costly is Plan 1 at $5.03 million. However, if the four seasons survey which is yet to be completed shows that mitigation of adverse environmental impacts is required, it is probable that the total project investment cost for all four alternatives will be comparable. The self-liquidating costs that would be borne by non-Federal interests would vary from a minimum of $3.58 million for Plan 2 to a maximum of $4.15 million for Plan 1 (see Table E1). Costs for replacing parking area lost due to encroachment (Plans 1 and 3) or additional parking required (Plan 2) are not included. In summary, and in the absence of a determination regarding mitigation, it is speculated that Plan 1 would be the most costly but least

environmentally damaging alternative, and Plan 4 the least costly but most environmentally damaging alternative. Plans 2 and 3 would fall somewhere in between when comparing the economic/environmental trade-offs.

With regard to social trade-offs, Plan 1 would sever convenient access between Beaches A and B while the other alternatives would preserve the integrity of this park feature. All plans would present an inconvenience to the visitor desiring to stroll along the shoreline in the park.

RATIONALE FOR PLANS ELIMINATED FROM FURTHER DETAILED STUDY (Plans 1 and 4)

Based on the District's consideration of the favorable and adverse aspects of the four structural plans studied in detail, formal and informal discussions and written communications with the Ohio Department of Natural Resources and the U.S. Fish and Wildlife Service, and the requirements set forth in the National Environmental Policy Act and Executive Order 11990, the Buffalo District concluded that Alternative Plans 1 and 4 should be eliminated from further consideration as viable solutions for meeting the recreational boating and shore-based fishing needs in the project area. However, as a result of coordination of the Stage 2 Report (July 1979) with North Central Division and Office, Chief of Engineers, it was concluded that it would be appropriate to still carry Alternative Plans 1 and 4 forward into Stage 3 planning. These alternative plans would then be used as a basis for evaluating and assessing the effectiveness of the structural plans that warrant further detailed study (Alternative Plans 2 and 3) when addressing the functional and environmental concerns at Geneva State Park. In addition, for Plans 1 and 4 it was also concluded that no additional study, such as formulating mitigation plans, refining the alternatives based on input provided by local boaters, etc., would be required in Stage 3 planning with the exception of updating the current cost estimate by price levels. Therefore, although Alternative Plans 1 and 4 have been eliminated from further consideration as "Candidate Selected Plans" for meeting the recreational boating and shore-based fishing needs in the project area, they will still be carried forward into Stage 3 planning and will be used as the basis for evaluating and assessing the effectiveness of the structural plans that warrant further detailed study in addressing the functional and environmental concerns at Geneva State Park.

The rationale for eliminating Plans 1 and 4 from further consideration other than for comparative purposes with Plans 2 and 3 follows.

## Alternative Plan 1 - Cowles Creek Harbor

The primary consideration in eliminating Plan 1 is the position stated by the Ohio Department of Natural Resources (ODNR) at the 29 May 1979 workshop (see paragaphs 15 and 16 of Exhibit F-3 in Appendix F) that they oppose this plan because it isolates the bathhouse and splits their beaches. Although ODNR requested that their official position on all of the structural alternatives be deferred until they had an opportunity to study the plans in depth, it is apparent that they will not accept Plan 1 because of the adverse impact on other park facilities and uses. The Buffalo District recognizes that the U.S. Fish and Wildlife Service prefers Plan 1 for several reasons and recommends that it be considered further (see Exhibits E-8 and E-9 of Appendix E). However, this plan is not considered viable because it is opposed by the local sponsor and therefore will not be considered further.

## Alternative Plan 4 - Wetlands Harbor

Plan 4 would destroy or disturb a major portion of the wetlands in the project area. Although this loss probably could be mitigated - at great expense - by artificially creating a wetland elsewhere, Executive Order 11990 dated 24 May 1977, prohibits Federal participation in projects which destroy wetlands if a practical alternative to such construction exists. Buffalo District has concluded that, as a minimum, Alternative Plan 2 is a practical alternative to Plan 4. Therefore Plan 4 will be eliminated from further consideration.

## RATIONALE FOR PLANS WARRANTING FURTHER DETAILED STUDY AS CANDIDATES FOR THE SELECTED PLAN (Plans 2, 3, and 5)

## Alternative Plan 2 - Offshore/Onshore Harbor

The U.S. Fish and Wildlife Service, by letter dated 2 July 1979 (Exhibit E-8), recommended that Plan 2 be given serious consideration as a practical design subject to future refinement. The opportunity for breakwater fishing would be two to three times greater for Plan 2 than for the other plans because of the greater breakwater length. Plan 2 also maintains the integrity of the other park features and uses and is economically viable with a B/C Ratio of 1.5. For these reasons it is concluded that Plan 2 should be considered further.

## Alternative Plan 3 - Wetland/Parking Lot Harbor

Plan 3 is considered to be a compromise between the environmental and functional concerns at Geneva State Park because it encroaches into both the wetlands and parking area. Although the U.S. Fish and

Wildlife Service recommends that Plan 3 be dropped from further consideration because there are practical alternatives involving lesser damage to the wetlands (see Exhibit E-8 of Appendix E), the amount of wetland destroyed would total only about 5 acres and could be mitigated, as necessary. In addition, of the practical alternatives to Plan 4 (the wetland plan), Plan 3 is the most economically efficient with estimated net benefits of $253,200 and a B/C Ratio of about 1.8. Plan 3, modified to provide either 300 or 360 slips, is preferred by ODNR. Based on sketches provided in a letter dated 17 July 1979 (see Exhibit E-10 of Appendix E), it is probable that the associated construction could be oriented to reduce the amount of wetland displaced. For these reasons, Plan 3 will be considered further.

Alternative Plan 5 - No-Action Plan

As with any potential water resources project, the no-action or do-nothing plan is carried forward as an alternative course of action in the event that more detailed studies show structural and/or non-structural plans can not be implemented because of the absence of engineering, economic, environmental, financial, social or political viability. Therefore, the no-action Plan 5 will be considered further, and will be used as the basis-of-comparison in evaluating the structural plans.

RATIONALE FOR CANDIDATE NED PLANS

Based on the results of an initial screening of 12 alternative plans, it was determined that four structural plans most nearly met the planning objectives for recreational facilities at Geneva State Park. Preliminary designs, estimates, economic evaluation, and environmental assessments were made for these Alternative Plans 1 through 4. In addition, the no-action Plan 5, which is always a possibility even though it would not satisfy any of the planning objectives, was considered in the second iteration of alternatives.

In selecting the National Economic Development (NED) plan, candidate plans must not only satisfy the planning objectives and evaluation criteria; they must also maximize net benefits. As repeatedly stated in the preceeding text, the need for mitigation of adverse environmental impacts and the breakwater fishing benefits have not yet been determined. In particular, the comparative results for each of the five candidate plans presented in Tables E1 and E2 could change significantly if mitigation is required. It is expected that the greatest increase would be for Plan 4 because it impacts most on the wetlands area. Based on existing data, costs and benefits, the NED plan would be Plan 4 with net benefits of $307,100.

However, any of the other three structural plans could provide maximum net benefits when all considerations are included. Therefore, a candidate NED plan cannot be selected at this time.

RATIONALE FOR CANDIDATE EQ PLANS

Recognizing that environmental quality has both natural and human manifestations, an EQ Plan addresses the planning objectives in the way which emphasizes aesthetic, ecological, and cultural contributions. Beneficial EQ contributions are made by preserving, maintaining, restoring, or enhancing the significant cultural and natural environmental attributes of the study area. Determination of EQ benefits involves subjective analysis, underscoring the need for interdisciplinary planning with extensive public input to place values on the environmental contributions of plans. Designating an EQ Plan involves measuring the environmental changes related to different plans and selecting the plan which, based on public input, contributes to or is most harmonious with environmental objectives. This means that candidate EQ Plans must make net positive contributions to the components of the EQ account. At a minimum, an alternative plan must make net positive contributions to the EQ account in order to be designated the EQ Plan.

In some studies, it may be impossible to develop a plan that meets the minimum requirements for designating an EQ Plan; i.e., a plan that makes net positive contributions to the EQ account. In those cases, the plan which is least damaging to the environment will be identified.

This is such a study where it is impossible to develop a plan that meets the minimum requirements for designating an EQ Plan. Therefore, the plan which is least damaging to the environment is described below.

Alternative Plan 2 (Offshore/Onshore Harbor) is considered to be the plan which is least damaging to the environment. The existing and future park facilities would not be disrupted. Also, and most importantly, the alternative would directly impact only a limited area in the northeast corner of the wetland area which could be compensated for with suitable mitigation.

# SECTION F
# STUDY MANAGMENT

The purposes of this section are to provide an outline of the principal activities needed to complete the Reformulation Phase I General Design Memorandum, the methodologies to be used, to describe the contemplated public involvement and coordination activities, and to provide information on the study schedule for the remainder of the Phase I study. The primary study goal in Stage 2 has been to evaluate a wide range of alternative plans that would satisfy the planning objectives with the purpose of reducing the number of alternatives for further consideration. The evaluation to this point in time indicates that there are two structural plans -Plans 2 and 3 and the no-action Plan 5 that should be considered further in Stage 3 as candidates for the "Selected Plan." The management plan presented herein assumes that these two structural plans - or some variation thereof - warrant further consideration.

STAGE 3 METHODOLOGY

The emphasis in Stage 3 will be placed on refining Plan 2 and Plan 3. The principal considerations in this refinement are: the views of local boaters regarding channel depths, width and aspect; mitigation of adverse environmental impacts based on the results of the U.S.F. & W.L.S. four-season survey; and modification of the configuration of the mooring areas based on such factors as ODNR's preference for number of berthing spaces, and location of the launching ramps, service facilities and parking areas. Another important consideration is a review of the results of the boating demand analysis that was performed in Stage 2. These results show that the proposed 400-boat facility at Geneva State Park would nearly meet the 1990 need for the contiguous area. This being the case, contemplated small boat facilities at other locations, such as Ashtabula, OH, about 12 miles to the east, could be negatively impacted upon. For this reason, the District will work closely with affected State, county, and local agencies on this matter. Another consideration is the results of the Stage 2 shore-based fishing demand analysis which indicates that existing peak-day capacity on Lake Erie in Ashtabula County significantly exceeds projected future demands. Thus, reevaluation of fishing demand will be made in Stage 3 to verify the Stage 2 results.

The Study Flow Network (CPM) showing the activities involved in the remainder of the Phase I study is presented on Figure H-1 of Appendix H. With reference to the CPM, the future involvement of the interdisciplinary team in the remaining Phase I effort is as follows.

Coastal Engineering - Refine the considered alternative(s) layouts based on ODNR's master plan for the marina facility, U.S. Fish and Wildlife Service input, and input received at a boaters' workshop and public meeting which are scheduled after completion of Corps review of the Stage 2 report (Milestone 25). Review and refine the wave refraction/defraction analysis and then refine the breakwater-entrance channel designs based on the agency and user input and refined wave analysis. When other activities such as coordination, monitoring the model study process, and report preparation are included, the Coastal Engineering effort totals three man-months. This work is programmed to be done in-house.

Environmental - Contract work consists of an Interagency Support Agreement with the USF&WLS to complete the Coordination Act activities and a contract to perform a cultural resources reconnaissance of the project site. The in-house effort involves five man-months to prepare the Draft EIS and 404 evaluation; approximately 1-1/2 man-months to prepare the Final EIS; and 2-1/2 man-months to monitor the Coordination Act work and cultural resources contract, provide input into the formulation process and report preparation. The total environmental in-house effort is about nine man-months.

Economics - Economics work involves: finalize the demand analysis (one man-month); finalize the economic evaluation (1-1/2 man-months); coordination and preparation of the draft and final Phase I report (1-1/2 man-months) - totalling four man-months of in-house effort.

General Engineering - The work involved includes: preparation of the final cost estimate (one man-month); preparation of the cost appendix (one-half man-month); and one man-month to prepare the appropriate Intensive Management documents for a total of 2-1/2 man-months' work.

Foundations and Materials - This work totals about four man-months of in-house effort about equally distributed between a stability analysis and construction materials determination for the sideslopes of the excavated mooring area (two man-months); and a materials survey and preparation of the report appendix (two man-months).

Real Estate - The appraisal would be performed over a three-month period by the North Central Division.

Drafting - About 3 man-months of in-house effort will be required. This involves preparation of visual aids for the public meetings and workshops and graphic displays for the draft and final Phase I reports.

Model Study - The Waterways Experiment Station (WES) in Vicksburg, MS, will do the model study. The District elected to perform most of the model study in Phase I to expedite Phase II final design.

Project Management and Planning - The study manager is expected to spend approximately 50 percent of his time (7 man-months) involved in Stage 3 activities, primarily in coordinating efforts of the interdisciplinary team, preparation of materials for public meetings and workshops, coordination with other agencies and boating interests, and report preparation.

## PUBLIC INVOLVEMENT AND COORDINATION FOR STAGE 3

A workshop with boating interests in the area will be held in the 3rd Quarter of FY 80, as will a public meeting. In addition, a technical workshop will be held with ODNR and the USF&WLS to review the results of the four-seasons survey currently being conducted. The District has also scheduled a second technical workshop with ODNR and USF&WLS at about the time we are completing the refined designs (August 1980). A final public meeting will be held in the 2nd Quarter of FY 81 to present the findings of the Phase I study. Coordination will be maintained with ODNR and USF&WLS throughout Stage 3 to insure that these principal study interests are kept informed of Stage 3 developments and to obtain their input as the study progresses.

## PHASE I GDM STUDY SCHEDULE

The milestone dates shown on the CPM are essentially the same as those presented in the Plan of Study (POS) dated April 1978 (see Inclosure 5-1 of the POS). From the CPM, the Draft Phase I is scheduled for submittal to North Central Division in October 1980 (MS-26) and the Final Phase I (MS-30) in April 1981.

## SCHEDULE OF MAJOR ACTIVITIES THROUGH CONSTRUCTION

The schedule for the major activities is shown in Figure H-2 of Appendix H. The Phase II Design Memorandum would be initiated in FY 81 and completed in the 3rd Quarter of FY 82. Plans and Specifications would be completed early in FY 83. Construction is projected to start in mid-FY 83 and completed in the 1st Quarter of FY 85.

# SECTION G
# CONCLUSIONS

## POTENTIAL STUDY DIRECTIONS

There are several inter-related matters in the immediate study area and the region that are potential conflicts and therefore could impact upon the study direction outlined previously. This Phase I investigation addresses the recreational boating and fishing needs at Geneva State Park. Another water-related problem at the Park is beach and bluff erosion which ODNR would like rectified. Although this related need was considered to the extent that we feel confident, contemplated recreational boating improvements would be compatible with improvements in the interest of shoreline protection, some overlooked factor that adversely effects the viability of constructing shoreline protective works could surface thus requiring redesign of the recreational boating facilities.

Based on the recreational boating demand analysis performed in Stage 2, a 400-boat facility at Geneva State Park would satisfy the projected demand in Ashtabula County, OH to about 1990. If the proposed Stage 3 reanalysis produces substantially the same results, a serious conflict could exist, particularly with the city of Ashtabula where local interests desire comparable small boat facilities. The District will work closely with affected interests in Stage 3 to insure resolution of this potential conflict if it does come about.

## LOCAL SUPPORT

Strong local support for recreational boating facilities at Geneva State Park was expressed by all who spoke at the Initial Public Meeting in Geneva on 22 March 1978. The concensus appeared to be that they consider Geneva State Park to be an ideal location because of its quiet setting and the tourists and recreationists it would attract to this resort area. This support by citizens from the Ashtabula area might well be withdrawn if further analysis of boating demand shows that construction at Geneva State Park could delay or preclude similar works at Ashtabula.

The Ohio Department of Natural Resources has stated this recreational navigation project is one of their top priority projects as development of the small-boat facilities at Geneva State Park is imperative to promoting optimal use of the Park and satisfying the boating demand of northeast Ohio. In addition, ODNR has stated construction of all-weather facilities at Geneva State Park would be a major step in completing Ohio's program to establish a harbor-of-refuge at no more than 15-mile intervals along the Lake Erie shoreline.

*POLICY AND OTHER ISSUES TO RESOLVE*

The District interpreted the requirements of Executive Order 11990 to preclude further consideration of Alternative Plan 4 (the wetland area plan) because there were practicable alternatives (i.e. - Plans 2 and 3) to Plan 4. Review of and guidance on, this rationale was requested when the Stage 2 Report (July 1979) was coordinated with North Central Division and Office, Chief of Engineers. As a result of this review, it was concluded that Alternative Plans 2 and 3 could be considered as practical alternatives, as defined by Executive Order 11990, if the wetlands lost because of the project (2.6 acres and 5.0 acres for Plans 2 and 3, respectively) could be replaced in-kind. Subsequent coordination with the U.S. Fish and Wildlife Service and an evaluation of the existing biological information by Buffalo District indicated that it would be feasible to replace any wetlands lost due to Alternative Plans 2 and 3. Therefore, Alternative Plans 2 and 3 will be considered as practical alternatives to Plan 4.

The other issues that must be resolved generally involve conflicts between principal study participants outside the Corps. These issues have been identified and discussed in the preceding sections of this Stage 2 Report.

# SECTION H
# RECOMMENDATIONS

It is recommended that the District proceed with a Stage 3 level of investigation and prepare a Phase I GDM for the Geneva-on-the-Lake (Geneva State Park) Small Boat Harbor Project.

APPENDIX A

GEOLOGY, SOILS, AND CONSTRUCTION MATERIALS

GENEVA-ON-THE-LAKE SMALL-BOAT HARBOR

STAGE 2 REPORT
OF
REFORMULATION PHASE I GENERAL DESIGN MEMORANDUM

U.S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, NY 14207

GENEVA-ON-THE-LAKE, OHIO

GENERAL DESIGN MEMORANDUM
PHASE I
STAGE 2 REPORT

APPENDIX A
GEOLOGY, SOILS, AND CONSTRUCTION MATERIALS

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## Table of Contents (Cont'd)

### Tables



### Figures



### Plates

## Plates

## REGIONAL GEOLOGY

### A1. PHYSIOGRAPHY

Geneva-on-the-Lake, Ohio, is located within the eastern lake section of the Central Lowlands physiographic province. This area is characterized as having low relief transversed by east-west trending, gravelly ridges. Maximum relief occurs along the Lake Erie shoreline where steep bluffs of till and clay rise as high as 60 feet above the lake.

### A2. BEDROCK

Bedrock underlying northeastern Ohio consists of Upper Devonian shale interstratified with a few siltstone beds. The Cleveland Shale of the Ohio Formation is exposed in western Ashtabula County and the Chagrin Formation is exposed in eastern Ashtabula County.

### A3. STRUCTURAL GEOLOGY

The geologic structure of Ohio is relatively simple. In northeastern Ohio the dip is principally to the south. There are no major structures in the immediate area. The largest fold in Ohio is the north-plunging portion of the Cincinnati Arch which is called the Findlay Arch in the central portion of the State.

### A4. SURFICIAL GEOLOGY

Most of northeastern Ohio consists of material deposited during the late Wisconsinan. These deposits consist of till and stratified gravel, sand, silt, and clay. The lake escarpment Morainic System which forms a hummocky ridge about five miles south of Lake Erie consists mostly of till deposited within the last 14,000 years. Lakeward from the moraine are several ridges representing shorelines of former glacial great lakes. These ridges are about 10 feet high and consist of stratified sand and gravel. Near Ashtabula, the Whittlesey beaches reach a height of 70 feet. Towards the lake, the soils are clayey silt which are deposits of the former high level lakes and till.

A5. Recent deposits are beach sand along the lake and gravelly alluvium in the major streams.

### A6. GROUND WATER

Nearly 80 percent of Ohio's ground water is from sand and gravel aquifers. The highest yields are derived from filled proglacial valleys which are linear north-south trending features.

## LOCAL GEOLOGY

### A7. BEDROCK GEOLOGY

Bedrock underlying the project site consists of shale of the Chagrin Formation. This is a greenish-gray shale interbedded with soft blue shale in its upper part, and is a blue-gray clay shale with thin layers of hard concretions in its lower section. Sand content increases eastward toward Pennsylvania. According to Cushing (1931), fragments of the rock readily crush to a powder with a hammer and on exposure it weathers very quickly to a soft sticky clay. The Chagrin Formation is about 1,200 feet in thickness.

A8. A seismic survey was performed to determine the bedrock surface at the project site. Results are shown on Plates A2 and A3. The configuration of the rock shows that it is relatively flat lying but cut by several channels. The major channel is about 500 feet wide, 20 feet deep, and trends in an east-west direction. This channel appears to be filled mostly with till and silt as shown on the auger logs. Top of rock varies from elevation of 532.5 to 580 feet (IGLD, 1955).

### A9. SURFICIAL GEOLOGY

The surficial deposits at the proposed project site consist of glacial till, glacial-fluvial gravel, and clayey silt. According to Gross and Moran (1971), till in this part of Ohio has a silt sand-silt-clay ratio of about 28/46/26, with occasional large boulders. Seismic refraction studies show that the till varies in thickness from 0 to 31 feet. Overlying the till are sand and gravel, silt, and fill. The fill is predominantly silt and was borrowed from the pond areas shown on Plate A4.

### A10. SEDIMENTATION

The effects of sedimentation on the alternatives will be addressed in Stage 3 of the Phase I General Design Memorandum. Sediment problems will be small if Alternative 2, 3, or 4 is selected due to bank stabilization and offshore structures to limit input of material transported from the lake. Alternative 1 will require more detailed study because of discharges from Cowles Creek. The hydraulic characteristics and soil conditions in the Cowles Creek drainage basin will be studied to determine whether sediment control measures need to be considered.

A11. GROUND WATER

Ground water was not encountered during augering at the project site in 1978 but is probably controlled by the Lake Erie water level. Some seepage in the excavations will occur at the top of the till because it is relatively impermeable and is overlain by more permeable beds.

## SUBSURFACE INVESTIGATIONS

A12. PROGRAMS FOR EARLIER STUDIES

Subsurface programs for previous studies included a series of probings, soundings and Porter Sampler borings (Plate A1). During 1965, 32 probings were performed in the general area of the proposed small-boat harbor. Those probings were obtained using a 3/4-inch hexagonal rod and were driven to "refusal" with an eight-pound sledge hammer. A portable hand-held drill was used to obtain 19 explorations (probes) that were drilled to "refusal." The term "refusal" was not defined in either of the above techniques.

A13. In 1966, three small diameter drive borings were obtained by use of a "Porter Sampler" to determine the visual classification of the overburden. No testing was performed. For the Shore Erosion Demonstration Project, 27 probes were performed in 1977 and 1978. Those probes generally were obtained offshore.

A14. PROGRAM FOR CURRENT STUDY

General

Subsurface investigations were performed in 1978 and consisted of a geophysical survey and auger borings. Surface investigations consisted of a bathymetric survey performed in 1977 and 1978. The location of the seismic lines, auger borings, and offshore sounding lines are shown on Plate A1.

A15. GEOPHYSICAL SURVEY

The survey consisted of 14 lines (approximately 11,000 linear feet) arranged over the general area to include the various alternative sites. The geophysical data was recorded by a 12-channel seismograph. The subsurface data was interpreted and geologic profiles were drawn along each seismic line.

A16. AUGER BORINGS

In order to provide some limited control for the seismic survey, eight auger borings were drilled to refusal.

A17. BATHYMETRIC SURVEY

Offshore soundings were recorded by the integrated sounding system in the summer of 1977 and fall of 1978 to -20 feet LWD (568.6-IGLD). The sounding lines were arranged over the general offshore area to include the various alternative sites. The data was plotted by computer and contour lines were drawn as shown on Plate A1.

A18. Grab samples were obtained during the offshore survey in 1977 using a Pederson Sampler. Sampling indicated an absence of sediment beyond the -3 foot LWD contour except in the vicinity of Cowles Creek where sediment extended to -6 LWD.

A19. DATA INTERPRETATION

Geologic classifications were made based on velocities shown in Table A1.

Table A1 - Geologic Classification Based on Velocity

| Seismic Zone | Velocity Range (feet per second) | Geologic Material |
|---|---|---|
| I | 1,050-2,500 | Fill, alluvium, lake deposits or outwash |
| II | 3,600-6,900 | Glacial Till |
| III | 7,000 | Bedrock |

A20. Probes, Porter Sampler borings, soundings, and auger borings were utilized to supplement data interpretation. The top of till and top of bedrock were contoured (Plates A2 and A3).

The bedrock surface (Plate A3) interpreted from the seismic survey indicates the presence of an east-west trending valley that opens northward (lakeward). This valley is incised 10 feet into rock. Since the valley does not appear to follow any local or regional structure, it probably provided major drainage through the area before the last glaciation. The bedrock high of 565 feet (IGLD) is below the present shoreline and may be the result of meander activity. A bathymetric map offshore of this channel indicates that the present lake bottom surface is superimposed on this feature, and the valley can be traced for several hundred yards offshore. The till surface (Plate A2) is irregular but follows the general trend of the bedrock. The till is thickest in the bedrock valley and thinner at the higher elevations. The irregularities of the till surface are

masked by the lacustrine deposits of former glacial great lakes. The four alternatives proposed were determined from the configuration of the glacial till and bedrock contours.

Geologic sections were made for each alternative. The locations of the sections are shown on Plates A4, A6, A8, and A10. The typical sections are shown on Plates A5, A7, A9, and A11.

## GEOTECHNICAL DESIGN

### A21. GENERAL

Presumptive values for soil and rock were used. The design for soil and bedrock cuts are conservative. For soil, the slopes are 1V on 3H, for bedrock, the cuts are vertical since they will remain underwater. Sand, gravel, and silt that overlie the glacial till should not be difficult to excavate. Seismic velocities of 3,000 to 6,700 feet per second indicate that the till is rippable, but in these areas where the velocities approach 6,700 feet per second, drilling and blasting may be required. Typical seismic velocities of 7,000 to 14,000 feet per second indicate that the bedrock also is marginally rippable to nonrippable using a D9H ripper. Bedrock excavation probably will require drilling and blasting.

### A22. APPROACH CHANNELS

Bedrock is assumed to be below grade in the approach channels. A veneer of fine grained sand ranges in thickness up to four feet near the shoreline. Rock excavation probably will not be required for the approach channel in the lake or onshore.

### A23. INTERIOR CHANNELS AND MOORING AREAS

A variety of overburden soil types will require excavation. Generally, bedrock is below grade; however, for some alternatives, bedrock may require excavation.

### A24. RETAINING WALLS

Several alternatives will require a concrete cantilevered or "T" retaining wall in order to minimize encroachment in the parking lot. These walls generally will be founded on the glacial till; however, in some cases rock excavation may be required.

### A25. GEOTECHNICAL DESIGN VALUES

The following table presents the values used for the geotechnical design.

Table A2 - Presumptive Values for Geotechnical Design

| Soil/Rock Type | Unit Weight (dry) PCF | Unit Weight (Total) PCF | Cohesion PSF | Angle of Internal Friction |
|---|---|---|---|---|
| Till, Alluvium, Lake Deposit, Outwash (Seismic Zone I) | 99 | 124 | 0 | 30° |
| Glacial Till Pebbly (Seismic Zone II) | 132 | 145 | 0 | 35° |
| Glacial Till Dense (Seismic Zone II) | 132 | 145 | 0 | 45° |
| Shale (Seismic Zone III) | 150 | 165 | 4500 | 45° |

A26. BREAKWATERS

Side slopes for the proposed breakwaters are 1V:1.5H. Foundations are assumed to be sands and shales. Slope stability analyses using the Bishop Method of slices were performed. The resulting factor of safety is 1.54 and is based on 16 computer runs at eight locations.

A27. The following assumptions were used to determine the safety factor for the breakwaters:

Angle of Internal Friction for Foundation Material - 45°

Cohesion for Foundation Material - 0 PSF

For underlayer stone a unit weight of 114.8 PCF was used.

For stone materials placed underwater, a unit weight of 68.8 PCF was used.

All bedding materials will be placed underwater; therefore, for bedding, a unit weight of 69.4 PCF was used.

For armor stone above water, a unit weight of 113.1 PCF was used; for below water, a unit weight of 67.5 PCF was used.

A28. The computer printout for the slope stability analyses for the east and west breakwaters is shown on the following pages.

NEW YORK STATE DEPARTMENT OF TRANSPORTATION

SLOPE STABILITY ANALYSIS

PROGRAM NO. SS17300/SOILSL DEVELOPED FEBRUARY,1970

GENEVA-ON-THE-LAKE, SMALL BOAT HARBOR
SLOPE STABILITY ANALYSIS - BISHOPS METHOD OF SLICES
EAST AND WEST BREAKWATERS
VALUES ARE ESTIMATED
FIRST RUN - 9 APRIL 1979

INPUT DATA

SOIL LINES

| LINE | SOILHL FT | SOILVL FT | SOILHR FT | SOILVR FT | WEIGHT PCF | PHI DEG | COHES PSF |
|---|---|---|---|---|---|---|---|
| 1 | -14.00 | 0.00 | 0.00 | 0.00 | 113.10 | 45.0 | 0.00 |
| 2 | 0.00 | 0.00 | 23.00 | -14.80 | 113.10 | 45.0 | 0.00 |
| 3 | 23.00 | -14.80 | 38.00 | -24.30 | 67.50 | 45.0 | 0.00 |
| 4 | -14.00 | -12.30 | -3.00 | -12.30 | 114.80 | 45.0 | 0.00 |
| 5 | -3.00 | -12.30 | 1.00 | -14.80 | 114.80 | 45.0 | 0.00 |
| 6 | 1.00 | -14.80 | 15.00 | -24.30 | 58.80 | 45.0 | 0.00 |
| 7 | -14.00 | -18.00 | -4.00 | -18.00 | 69.40 | 45.0 | 0.00 |
| 8 | -4.00 | -18.00 | 5.00 | -24.30 | 69.40 | 45.0 | 0.00 |
| 9 | 5.00 | -24.30 | 15.00 | -24.30 | 69.40 | 45.0 | 0.00 |
| 10 | 15.00 | -24.30 | 38.00 | -24.30 | 69.40 | 45.0 | 0.00 |
| 11 | 38.00 | -24.30 | 43.00 | -24.30 | 69.40 | 45.0 | 0.00 |
| 12 | 43.00 | -24.30 | 45.00 | -26.30 | 69.40 | 45.0 | 0.00 |
| 13 | -14.00 | -26.30 | 45.00 | -26.30 | 150.00 | 45.0 | 4500.00 |
| 14 | 45.00 | -26.30 | 200.00 | -26.30 | 150.00 | 45.0 | 4500.00 |

WATER TABLE LINES

| LINE | WATRHL FT | WATRVL FT | WATRHR FT | WATRVR FT |
|---|---|---|---|---|
| 1 | -14.00 | -14.80 | 200.00 | -14.80 |

RADIUS INCREMENT IS 5.0 GRID INCREMENT IS 5.0

| SEPMOM FT-KIP | DRVMOM FT-KIP | PHIMOM FT-KIP | CHSMOM FT-KIP | HORZON FT | VERTCL FT | RADIUS FT | FSNYS | FSBIS |
|---|---|---|---|---|---|---|---|---|
| 0. | 934. | 1918. | 0. | 26.0 | 13.0 | 39.3 | 2.054 | 2.321 |
| 0. | 1438. | 3766. | 8472. | 26.0 | 13.0 | 44.3 | 9.509 | 9.212 |
| 0. | 331. | 543. | 0. | 31.0 | 13.0 | 34.3 | 1.644 | 1.802 |
| 0. | 811. | 1463. | 0. | 31.0 | 13.0 | 39.3 | 1.804 | 2.032 |
| 0. | 154. | 239. | 0. | 36.0 | 13.0 | 34.3 | 1.552 | 1.644 |
| 0. | 596. | 985. | 0. | 36.0 | 13.0 | 39.3 | 1.652 | 1.856 |
| 0. | 25. | 37. | 0. | 41.0 | 13.0 | 34.3 | 1.512 | 1.542 |
| 0. | 347. | 560. | 0. | 41.0 | 13.0 | 39.3 | 1.619 | 1.778 |
| 0. | 139. | 232. | 0. | 46.0 | 13.0 | 39.3 | 1.667 | 1.793 |
| 0. | 591. | 1701. | 8472. | 46.0 | 13.0 | 44.3 | 17.211 | 19.119 |
| 0. | 70. | 106. | 0. | 41.0 | 18.0 | 39.3 | 1.528 | 1.565 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 0. | 513. | 827. | 0. | 41.0 | 15.0 | 44.3 | 1.613 | 1.766 |
| 0. | 241. | 399. | 0. | 46.0 | 18.0 | 44.3 | 1.614 | 1.729 |
| 0. | 832. | 2212. | 9936. | 46.0 | 18.0 | 49.3 | 14.596 | 15.449 |
| 0. | 253. | 399. | 0. | 36.0 | 15.0 | 39.3 | 1.577 | 1.673 |
| 0. | 791. | 1354. | 0. | 36.0 | 18.0 | 44.3 | 1.712 | 1.892 |

SEARCH HAS USED BISHOP FACTOR OF SAFETY
THE MINIMIM FACTOR OF SAFETY IS 1.542
THE CRITICAL CIRCLE CENTER COORDINATES ARE
HORZON IS 41.0 VERTCL IS 13.0
RADIUS IS 34.3

16 FACTORS OF SAFETY HAVE BEEN COMPUTED AT 8 LOCATIONS

A29. SLOPE PROTECTION DESIGN

Mooring basin slopes in overburden will require slope protection. Only one-foot wave heights are anticipated within the mooring basin. Therefore, 12-inch riprap over a bedding/filter will be adequate. Computation for both riprap and bedding/filter are shown on the following pages.

Page ___ of ___ pages.

Subject: GENEVA on the LAKE OH
Computation of: BEDDING / FILTER FOR SLOPE PROTECTION
Computed by: JAG / Checked by: MLH Date: 20 JUNE 79

ASSUMPTIONS :

1. SILTY CLAY :

$D_{85}$ (Soil) = 0.01 mm
$D_{15}$ (Soil) = 0.004 mm
$D_{50}$ (Soil) = 0.04 mm

$D_{15}$ (Riprap) / $D_{15}$ (Filter) $\geq 5$

$D_{15}$ (Filter) / $D_{85}$ (Soil) $\leq 5$

$D_{15}$ (Riprap) = 5.5" max = 140 mm max
$D_{15\,min}$ Riprap = 4.0" = 102 mm

$D_{15}$ : $\frac{140}{x}$ mm $\geq 5$ ; $\frac{102}{x}$ mm $\geq 5$

x = 28 mm ; x = 20 mm

$D_{85}$ : $\frac{140}{x} \leq 5$ x = 28 mm

$\frac{102}{x} \leq 5$ x = 20 mm

FOR BEDDING / FILTER

$R_{50}$ = 9 to 30 $R_{50}$ = $D_{50}$ (filter) / $D_{50}$ (soil)
$R_{15}$ = 6 to 18 $R_{15}$ = $D_{15}$ (filter) / $D_{15}$ (soil)

$D_{15}$ filter $\leq$ 5 $D_{85}$ (soils)
x $\leq$ 5(.01)
x $\leq$ 0.05 mm

$R_{50}$ : 9 = x/0.04 m ; $D_{50}$ filter = .36 mm, 1.2 mm } $R_{50}$ Filter
30 = $\frac{x}{0.04}$

$R_{15}$ = 6 = $\frac{x}{.004}$ = .024 } $R_{15}$ filter
18 = x/.004 = .072 m

Page ___ of ___ pages.

Subject Geneva on the Lake OH
Computation of Riprap for Small boat harbor
Computed by JAG Checked by MLH Date 20 Jul 79

ASSUMPTIONS FOR RIPRAP DESIGN

1. Wave height - inside mooring basin : 1 foot
2. SSD of stone material : 2.5 (say 160 PCF)
3. Designed Slope 1v on 3H
4. Non breaking wave
5. ~~Rough~~ Graded, Angular; $K_{RR} = 2.5$ - graded product

FROM "SHORE PROTECTION MANUAL", pg 7-180

$W_{50} = W_r H^3 / K_{RR} (S_r - 1)^3 \cot\theta$ : WHERE: $\cot = 3$
$W_{50} = 160 (1)^3 / 2.5 (2.5 - 1)^3 (3)$ ; $W_r = 160$ PCF ; $H = 1$ FT
$W_{50} = 6.32$ Pounds ; SAY 6 POUNDS ; $S_r = 160/62.4$ ; $S_r = 2.5$

FROM ENGR FORM 4055; 6 pounds = ~4.5 inch stone.
FROM ETL 1110-2-60, pg 5&6 : Minimum thickness for practical placement is 12 inches.
FROM "SHORE PROTECTION MANUAL", pg 7-175 :
FOR $W_{50\,MAX}$ × 3.6 ; FOR $W_{50\,MIN}$ × 0.22
3.6 × 6.32 = 22.752 ; 0.22 × 6.32 = 1.39

FROM ETL 1110-2-120, 14 May 1971, pg 27 :

SPECIFIC WEIGHT = 160 PCF ; THICKNESS = 12 INCHES

| PERCENT LIGHTER BY WEIGHT | LIMITS OF STONE WEIGHT IN POUNDS |
|---|---|
| 100 | 84 - 34 |
| 50 | 25 - 17 |
| 15 | 12 - 5 |

## CONSTRUCTION MATERIALS

### A30. MATERIAL TYPES AND GRADATIONS

#### General

Required materials include armor stone, underlayer stone, core stone for the offshore breakwaters, bedding/filter, riprap for the slope protection, and aggregates for the concrete retaining wall within the small-boat harbor.

### A31. ARMOR STONE

For the various alternatives, a range of armor stone sizes are required. Therefore, armor stone may vary from 2.5 tons to 24 tons. Type A armor stone will consist of a uniform size stone ranging in size from 11 to 24 tons.

A32. Type B armor stone also will consist of a uniform size stone ranging in size from 3.5 to 8 tons. Type C armor stone will consist of a uniform size stone ranging in size from 3 to 6.5 tons. Type D armor stone will consist of a uniform size stone ranging in size from 2.5 to 5.5 tons.

### A33. UNDERLAYER STONE

Underlayer stone size also varies with the number of alternatives being considered. Therefore, the underlayer material will vary in size from 300 pounds to 4,800 pounds. Type E underlayer stone will consist of a randomly graded material ranging in size from 1,200 to 4,800 pounds. Type F underlayer stone will range in size from 400 to 1,600 pounds. Type G underlayer stone will range from 300 to 1,300 pounds. Type H underlayer stone will range from 295 to 1,100 pounds.

### A34. CORE STONE

These materials will vary in size in accordance to the design of the armor and underlayer stone. In general the sizes will range from 0.7 pounds to 240 pounds (2 inches to 15 inches). All core stone will be reasonably well graded. Type I core stone will range from 3 to 240 pounds. Type J core stone will range from 1 to 81 pounds. Type K core stone will range from 0.8 pounds to 65 pounds. Type L core stone will range from 0.7 pounds to 55 pounds.

A35. Gradations for each of the above core stone types are not shown. Generally one core stone will be produced to satisfy the requirements for each structure. In addition, suppliers generally will not produce more than one gradation for a project of this size.

If core materials are shipped by self-unloading vessels that stone size will be minus seven inches (-7") maximum size.

A36. BEDDING/FILTER MATERIAL

This stone material will consist of a reasonably well-graded material having the following gradation and shall fall within the limits of the gradation band shown on Figure A1.

| Sieve Designation U. S. Standard Square Mesh | Percent Finer by Weight |
|---|---|
| 5-inch | Maximum |
| 2-inch | 85-100 |
| 1-inch | 75- 90 |
| 3/4-inch | 72- 85 |
| No. 4 | 60- 75 |
| No. 16 | 45- 59 |
| No. 40 | 29- 45 |
| No. 100 | 10- 20 |
| No. 200 | 0- 5 |

A37. TWELVE-INCH RIPRAP

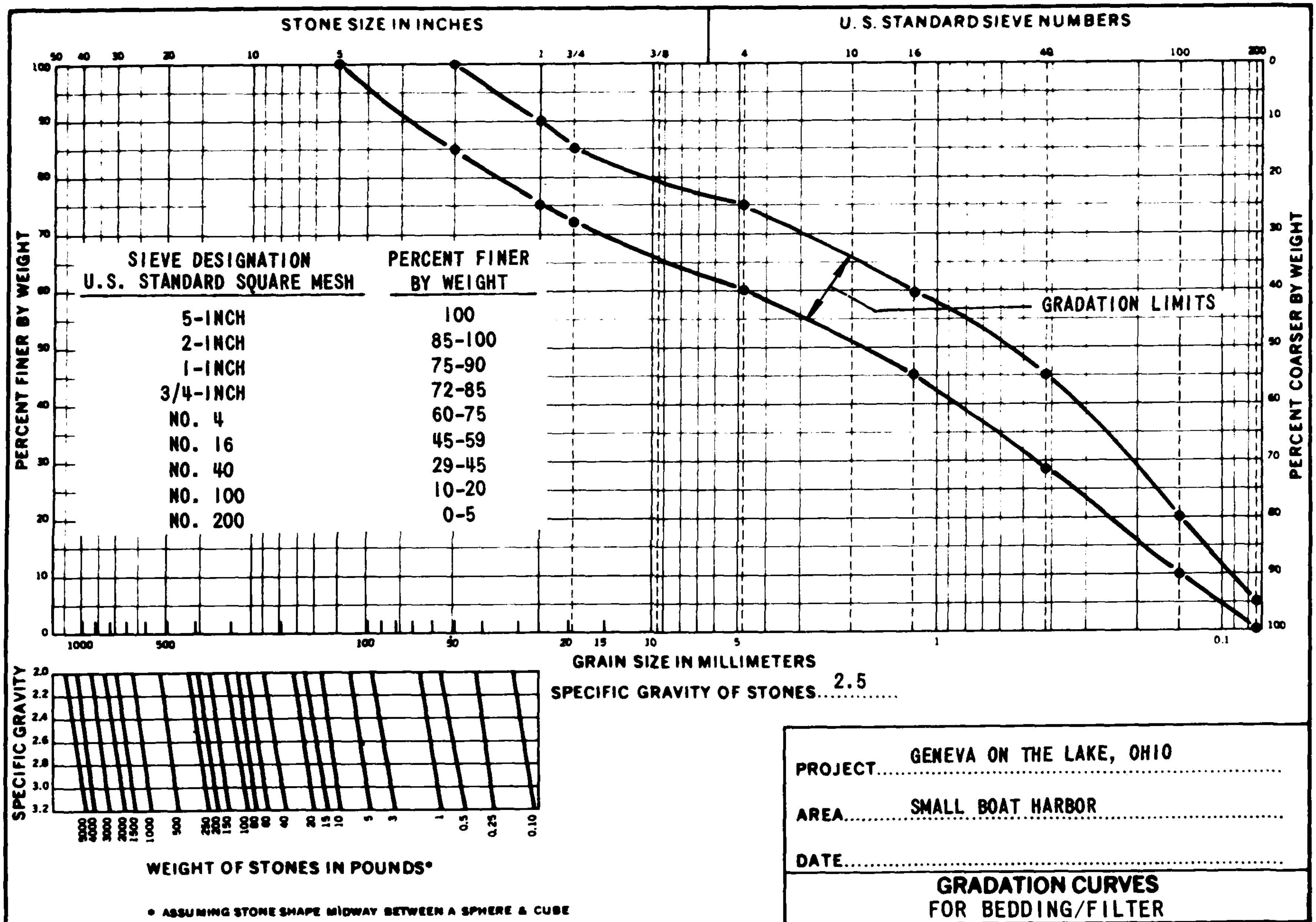
This stone will consist of a reasonably well-graded material having the following gradation and shall fall within the limits of the gradation band shown on Figure A2.

| Percent Lighter by Weight | Limits of Stone Weights in Pounds |
|---|---|
| 100 | 84-34 |
| 50 | 25-17 |
| 15 | 12- 5 |
| 5 | 10- 3.5 |

A38. Stones shall be predominantly angular in shape. Not more than 25 percent of the stones reasonably well distributed throughout the gradation shall have a length more than 2.5 times the breadth or thickness.

A39. COARSE AGGREGATE FOR CONCRETE

This material will consist of a reasonably well-graded aggregate having the following gradation and shall fall within the limits of the gradation band shown on Figure A3.




| SIEVE DESIGNATION U.S. STANDARD SQUARE MESH | PERCENT FINER BY WEIGHT |
|---|---|
| 5-INCH | 100 |
| 2-INCH | 85-100 |
| 1-INCH | 75-90 |
| 3/4-INCH | 72-85 |
| NO. 4 | 60-75 |
| NO. 16 | 45-59 |
| NO. 40 | 29-45 |
| NO. 100 | 10-20 |
| NO. 200 | 0-5 |

PROJECT GENEVA ON THE LAKE, OHIO

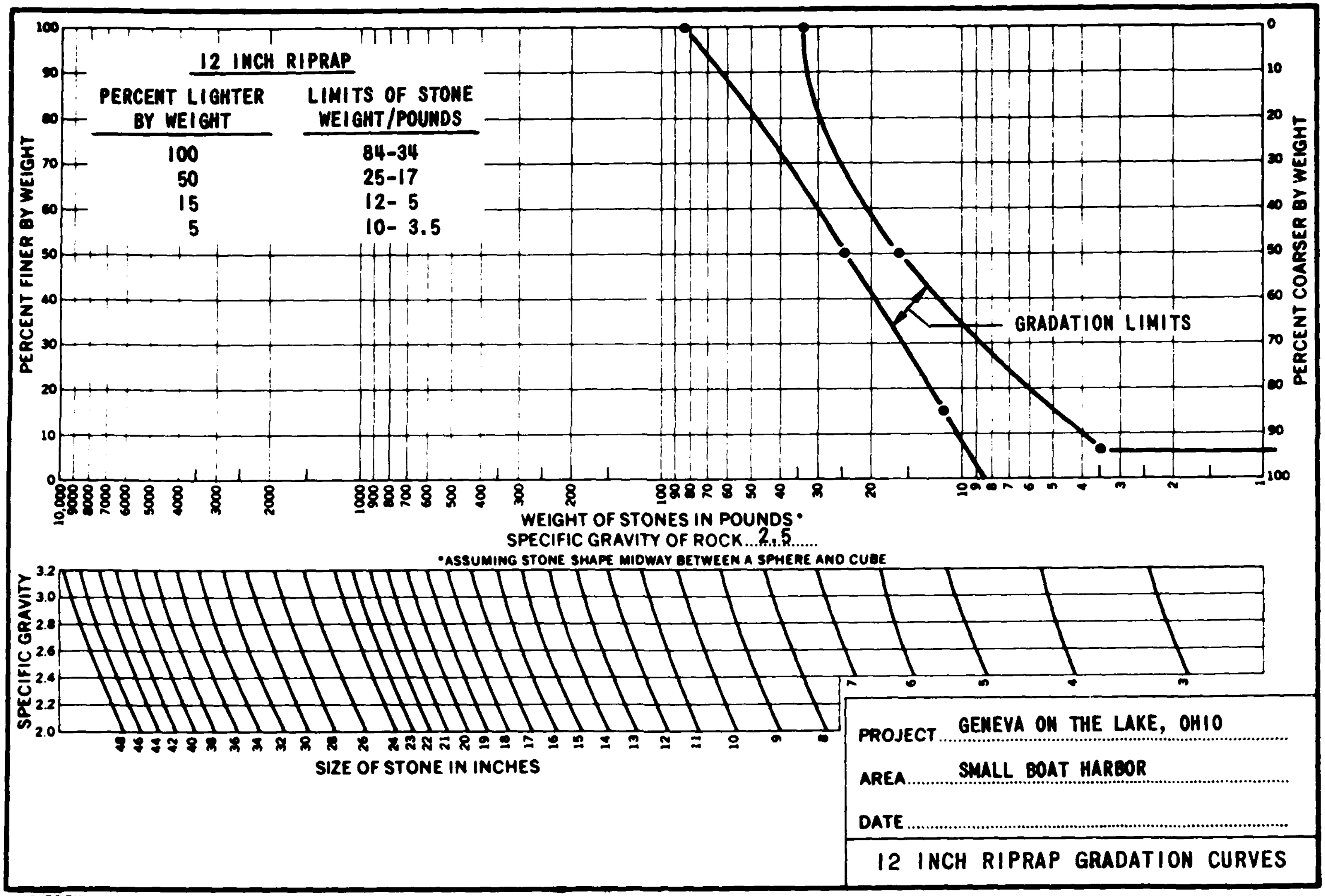
AREA SMALL BOAT HARBOR

DATE

**GRADATION CURVES**
FOR BEDDING/FILTER

ENG FORM 4056 APR 67

FIGURE A1




ENG FORM 4055
APR 67

FIGURE A2

| Sieve Designation U. S. Standard Square Mesh | Percent Finer by Weight |
|---|---|
| 1-1/2-inch | 100 |
| 1- inch | 95-100 |
| 1/2-inch | 25- 60 |
| No. 4 | 0- 10 |
| No. 8 | 0- 5 |

A40. FINE AGGREGATE FOR CONCRETE

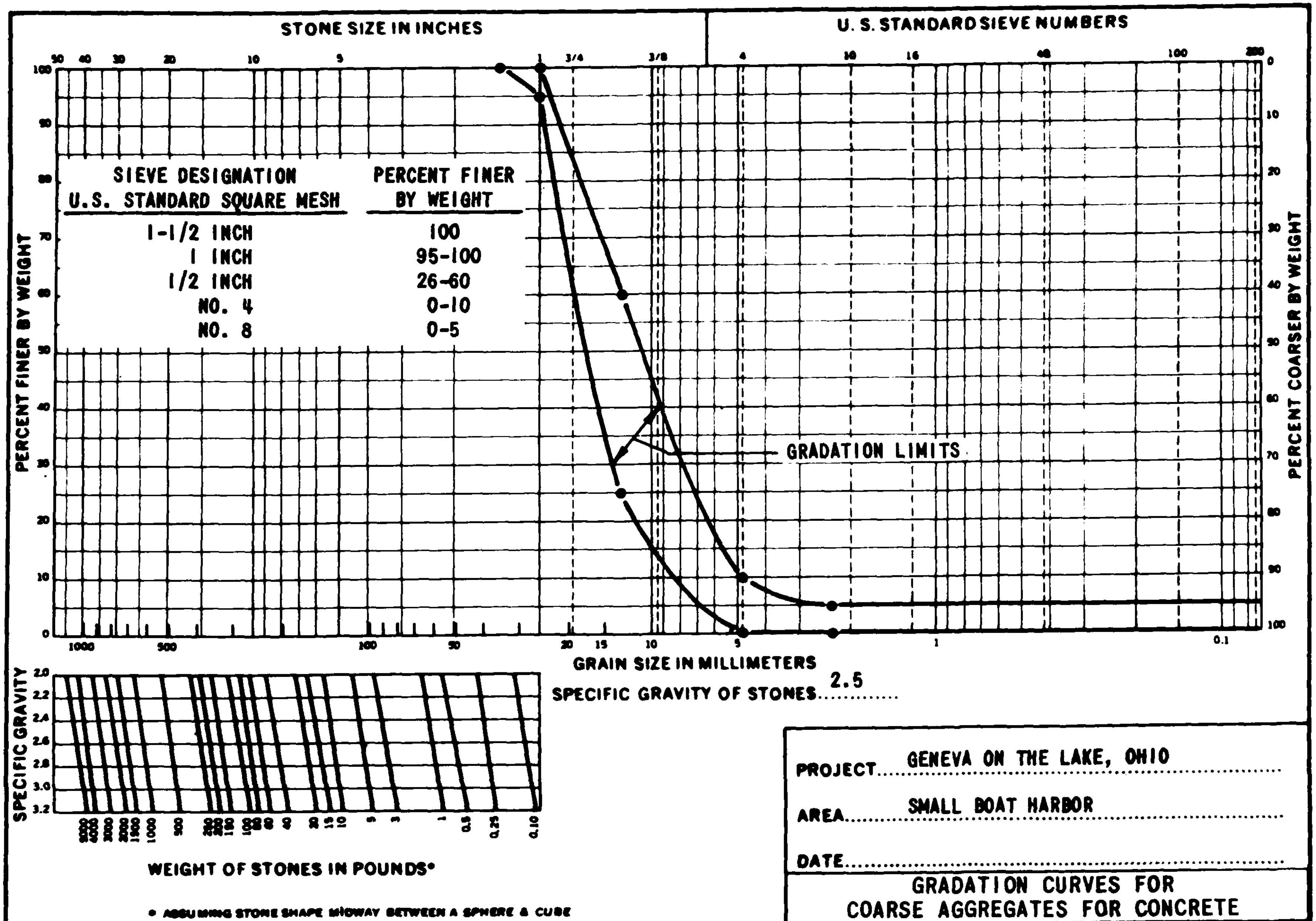
This material will consist of a reasonably well-graded aggregate having the following gradation and shall fall within the limits of the gradation band shown on Figures A4 or A5.

| Sieve Designation U. S. Standard Square Mesh | Percent Finer by Weight | |
|---|---|---|
| | Natural Sand | Manufactured Sand |
| 3/8-inch | 100 | |
| No. 4 | 95-100 | 100 |
| No. 8 | 70- 95 | 90-100 |
| No. 16 | 45- 80 | 50- 75 |
| No. 30 | 25- 60 | 30- 60 |
| No. 50 | 10- 30 | 14- 30 |
| No. 100 | 1- 10 | 4- 12 |
| No. 200 | 0- 4 | 0- 5 |

A41. Although armor stone, underlayer stone, core stone, graded riprap and randomly graded materials are not standard production items for most stone suppliers, most of the sources have produced satisfactory materials in the past. Contractors will be required to provide the selected sources adequate lead time to produce the various products. Some of the suppliers may require the Contractor to do his own sorting and blending in order to obtain the proper gradations for riprap. As several similar projects could be under construction at the same time as Geneva-on-the-Lake, the Contractor will be permitted to propose more than one source for each or any of the products required.

A42. MATERIAL WEIGHTS

The allowable minimum weight this design is based on is 156 pounds per cubic foot (2.5 SSD) for the bedding and for the 12-inch riprap. The design for armor stone, underlayer and core stone is based on 160 pounds per cubic foot (2.56 SSD).




| SIEVE DESIGNATION U.S. STANDARD SQUARE MESH | PERCENT FINER BY WEIGHT |
|---|---|
| 1-1/2 INCH | 100 |
| 1 INCH | 95-100 |
| 1/2 INCH | 26-60 |
| NO. 4 | 0-10 |
| NO. 8 | 0-5 |

PROJECT GENEVA ON THE LAKE, OHIO

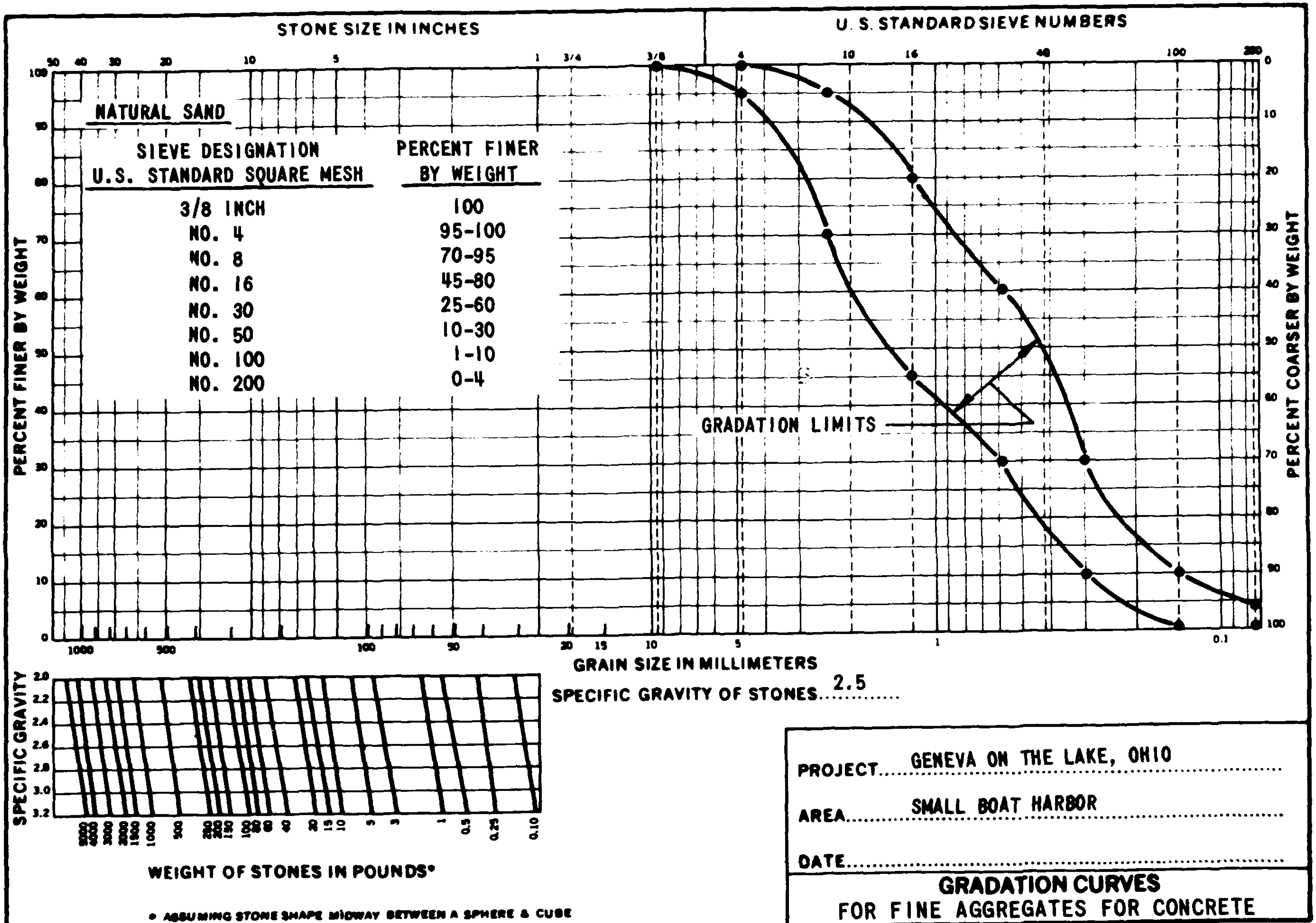
AREA SMALL BOAT HARBOR

DATE

GRADATION CURVES FOR COARSE AGGREGATES FOR CONCRETE

ENG FORM 4056 APR 67

FIGURE A3




NATURAL SAND

| SIEVE DESIGNATION U.S. STANDARD SQUARE MESH | PERCENT FINER BY WEIGHT |
|---|---|
| 3/8 INCH | 100 |
| NO. 4 | 95-100 |
| NO. 8 | 70-95 |
| NO. 16 | 45-80 |
| NO. 30 | 25-60 |
| NO. 50 | 10-30 |
| NO. 100 | 1-10 |
| NO. 200 | 0-4 |

SPECIFIC GRAVITY OF STONES 2.5

PROJECT GENEVA ON THE LAKE, OHIO

AREA SMALL BOAT HARBOR

DATE

**GRADATION CURVES**
FOR FINE AGGREGATES FOR CONCRETE

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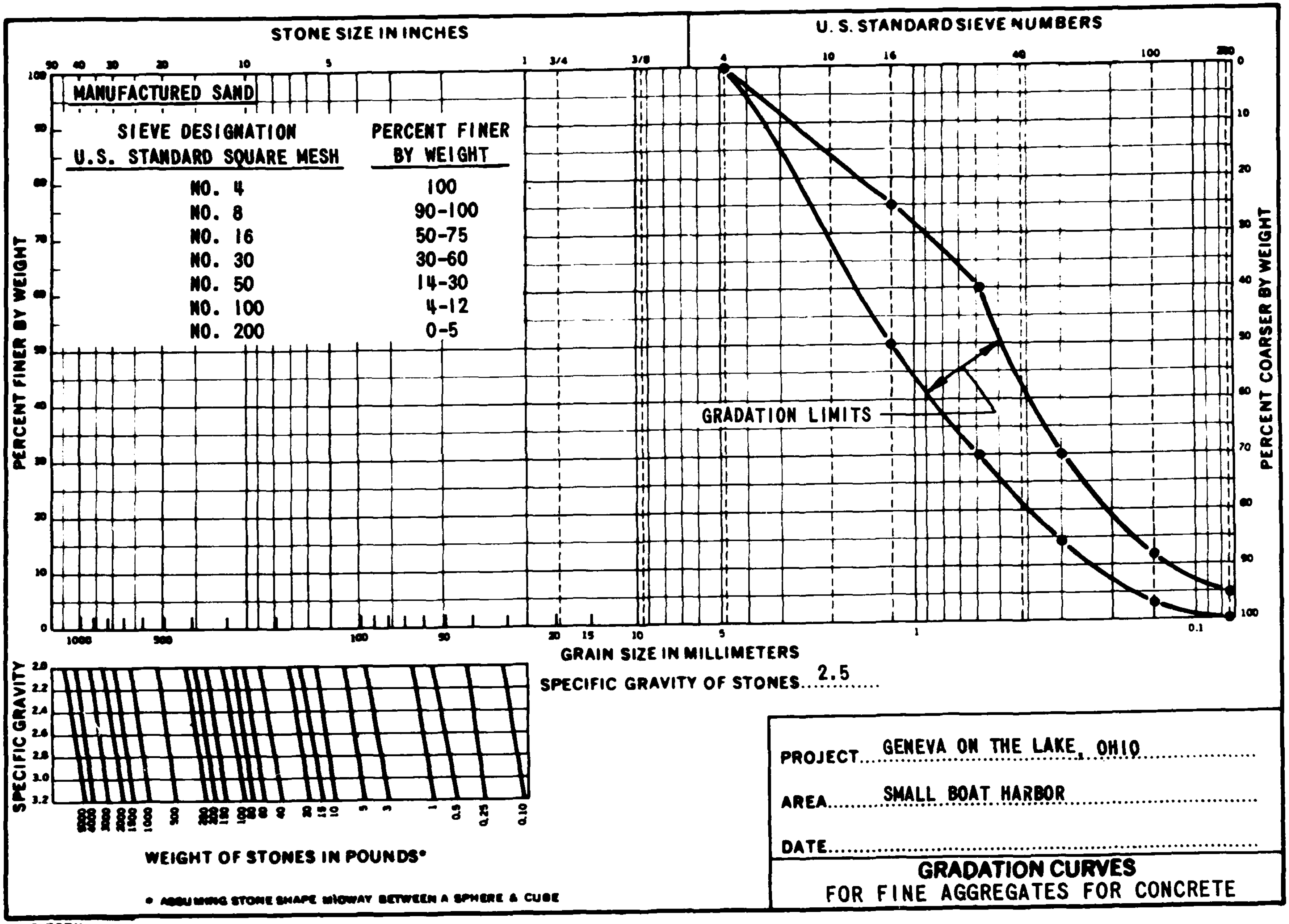
FIGURE A4




MANUFACTURED SAND

| SIEVE DESIGNATION U.S. STANDARD SQUARE MESH | PERCENT FINER BY WEIGHT |
|---|---|
| NO. 4 | 100 |
| NO. 8 | 90-100 |
| NO. 16 | 50-75 |
| NO. 30 | 30-60 |
| NO. 50 | 14-30 |
| NO. 100 | 4-12 |
| NO. 200 | 0-5 |

SPECIFIC GRAVITY OF STONES 2.5

PROJECT GENEVA ON THE LAKE, OHIO

AREA SMALL BOAT HARBOR

DATE

**GRADATION CURVES**
FOR FINE AGGREGATES FOR CONCRETE

ENG FORM 4056
APR 67

FIGURE A5

## MATERIAL QUALITY

### A43. GENERAL

Quality requirements for each material type are discussed below. Armor stone, underlayer, and riprap samples have been subjected to a series of tests established by the Ohio River Division Laboratories, Cincinnati, OH. Test number P-11, "Riprap and Breakwater Stone Evaluation," includes a series of tests to determine stone durability. The smaller sizes (i.e. bedding material, coarse and fine aggregates for concrete) have been subjected to a series of tests included in ORDL test numbers C-21 and C-22, "Elementary Acceptance Tests for Fine Aggregates (C-21) and Coarse Aggregates (C-22) for Civil Works."

### A44. MATERIAL QUALITY

Design criteria is a limiting factor on the number of available stone sources. Some stone producers have been eliminated from the list because their stone failed to meet the minimum specific gravity requirement (2.5). Possible sources for armor, underlayer, core stone, and riprap, bedding material, coarse and fine aggregates for concrete are listed on Plates A12 and A13.

### A45. ARMOR STONE, TYPES A, B, C, AND D

These stones will be a hard, durable, non-soluble material, free from visual cracks, seams, and overburden spoil. Only those sources from which the samples did not show any significant breakdown during the wet-dry and freeze-thaw tests are suitable. The wet-dry tests were performed for 80 cycles and the freeze-thaw tests for 35 cycles.

### A46. UNDERLAYER STONE, TYPES E, F, G, AND H

These stones will be a hard, durable, non-soluble material, free from visual cracks, seams, and overburden spoil. Only those sources from which the samples did not show any significant breakdown during the wet-dry and freeze-thaw tests are suitable. The wet-dry tests were performed for 80 cycles and the freeze-thaw tests for 35 cycles.

### A47. CORE STONE, TYPES I, J, AND K

These stones will be a hard, durable, non-soluble material that is reasonably free from visual cracks, seams and overburden spoil. Only those sources from which samples did not show any sigfnificant breakdown during the freeze-thaw or wet-dry tests are listed. Other tests included Los Angeles abrasion, magnesium sulfate loss, specific gravity and absorption, and a petrographic analysis.

A48. TWELVE-INCH RIPRAP

These stones will be a hard, durable, non-soluble material, free from visible cracks, seams, and overburden spoil. Only those sources from which the samples did not show any significant breakdown during the wet-dry and freeze-thaw tests are suitable. The wet-dry tests were performed for 80 cycles and the freeze-thaw tests for 35 cycles.

A49. BEDDING/FILTER

These stones will be a hard, durable, non-soluble material which is sound, free from visible cracks, seams, organic or deleterious material, and overburden spoil. Listed sources were subjected to tests such as the Los Angeles abrasion, magnesium sulfate loss, specific gravity and absorption, and a petrographic examination. Only suitable sources are listed.

A50. COARSE AND FINE AGGREGATES FOR CONCRETE

These materials will be a sound, hard, durable material, that is produced from a crushed product and shall be free from cracks, seams, organic, and deleterious materials. Aggregates that contain five percent or more of potentially reactive chert will require low alkali cement. Aggregates that contain a combined total of 20 percent or more of potentially reactive chert will not be permitted. Coarse aggregates will contain fractured sharp faces, and shall be free of laitence (washing of coarse aggregates may be required). Fine aggregates may be either natural sand (lake, beach, or glacial) or manufactured sand (crushed dolomite, limestone, or crushed conglomerates).

POSSIBLE SOURCES

A51. GENERAL

Armor stone, underlayer stone, core stone, riprap, bedding/filter, coarse and fine aggregate for concrete can be produced from those sources listed on Plates A12 and A13. However, all material from those sources may not be suitable. The right will be reserved in the specifications to reject materials from certain localized areas, zones, strata, channels, or stockpiles, when such materials become unsuitable.

A52. It is anticipated that selective quarrying will be required for armor stone, underlayer stone, and riprap. Blasting techniques used for normal aggregate production may require adjustments or, in some cases, complete tailoring to produce large size materials. Also, the specifications will require that shale and other undesirable

materials will be excluded by suitable and adequate processing. Only specific ledges and in some cases specific beds are suitable for the production of armor stone, underlayer stone, and riprap. The following presents quarries, lifts, materials produced, and where those materials were used.

A53. QUALITY QUARRIES

Quarry at Kelleys Island, OH. (Lucas and Amherstburg Dolomite) Lift 1. This lift produced 10-20 ton armor stone for the Buffalo Harbor confined Diked Disposal Area No. 4. The lower chert horizons in this lift were not acceptable. Lift 1A and the upper part of Lift 2 has been used to produce 12-24 ton armor stone for the Cleveland Harbor, OH, Confined Diked Disposal Area No. 14.

A54. STANDARD SLAG CO.

Marblehead Stone Division Quarry at Marblehead, OH (Lucas and Amherstburg Dolomite). This quarry operated three lifts. Lift 2 is the current top lift. It contains an abundance of chert and is not acceptable for any stone type for this project. Lift 3 is about 50 feet high and contains a variety of dolomites. The uppermost bed, unit 17, has been used successfully to produce a wide range of sizes, especially armor stone. Lift MH-1 is a low bench operation that has successfully produced armor stone for the Lorain Harbor, OH, Confined Diked Disposal Facility.

A55. In addition to armor stone, Marblehead Stone Division has produced core stone for Erie Harbor, PA, Diked Disposal Area; Cleveland Harbor, OH, Diked Disposal Areas 1, 2, 12, and 14; Lorain Diked Disposal Area, and Huron Diked Disposal Area. They have produced underlayer material for Erie Harbor, PA, Diked Disposal Area; Cleveland Harbor, OH, Diked Disposal Areas 2, 3, and 12; Lorain Harbor, OH, Diked Disposal Area; and Huron Harbor, OH, Diked Disposal Area. Filter stone also was produced by Marblehead Stone Division for Erie, Cleveland (1, 2, and 12) Lorain and Huron Diked Disposal Areas. Concrete aggregates from Marblehead Stone Division were obtained for Cleveland Harbor, OH, Dike 14, and for the West Breakwater repairs.

A56. FRONTIER STONE PRODUCTS CO.

Quarry at Lockport, NY (Lockport Dolomite). For the purposes of materials surveys this quarry has been subdivided into units. All units are within the Lockport Dolomite. Units 1 through 9 are in the Goat Island Member (34 feet), units below are in the Gasport Member. The Gasport Member is subdivided into three units FG-1 (top), FG-2, FG-3 (bottom). The Gasport is about 12 feet thick. The DeCew Member

is present in its full thickness but it is not acceptable for any materials to be used in this project.

A57. Armor stone ranging in size from 10 to 20 tons was produced from the Gasport Member for the Buffalo Harbor, NY, Confined Diked Disposal Area 4. Underlayer material ranging in size from 1,000 to 4,500 pounds also was produced from the Gasport Member for Buffalo Dike 4. Riprap (12 and 18-in) was produced from the Gasport Member for the Scajaquada Creek Flood Control Project. Riprap produced from the Goat Island Member for Scajaquada Creek Flood Project was rejected.

A58. This quarry also produces concrete aggregates and other crushed, graded products. The aggregates have been tested by ORDL and were found to be satisfactory. To date, concrete aggregates have not been used by the Corps of Engineers for any project. Concrete aggregates are approved for use by the NYSDOT.

A59. MEDINA SANDSTONE CO.

Quarry at Hulberton, NY. This quarry produces large material for use as cut stone. The quarry successfully produced 10-20 ton armor stone for the Buffalo Harbor Confined Diked Disposal Area 4. Large armor stone also was produced for channel breakwater construction at Oak Orchard Harbor, NY. Jetty stone also was successfully produced for Hamlin Beach, NY protection (groins) from this source.

A60. Concrete aggregates formerly were produced from this source; however, the quarry no longer produces aggregates or any other crushed products.

A61. This quarry is now inactive; however, stone materials may be obtained provided the Contractor and the owner reach agreement.

A62. ERIE BLACKTOP, INC.

Quarry at Castalia, OH, (Columbus Limestone). This quarry has produced riprap (200 pounds minus) for State Route 231 near Ashtabula, OH, and underlayer materials for the Lorain Harbor, OH, Confined Diked Disposal Facility. Crushed products are produced for blacktop operations. However, the Corps of Engineers has not tested or used crushed materials from this source.

A63. WHITEROCK QUARRY

(Ed Kraemer and Son, Inc.), quarry at Clay Center, OH, (Niagaran Dolomite). This quarry operates two lifts; the upper lift is about 80 feet high; the lower lift is about 20 feet high. Stone materials for the Lakeview Park Beach Improvement (160-1,200 pounds) and

Erosion Control Project, Lorain, OH, were successfully produced from the lower lift. However, selective loading is required as the upper part of the lower lift contains "reef rock" and that rock is highly fractured and is not acceptable for use for this project.

A64. WOODVILLE LIME AND CHEMICAL CO.

Quarry at Woodville, OH, (Niagaran Dolomite). This quarry operates one 80-foot high lift. The quarry produced successfully 12 and 21-inch riprap for the Sandusky River Flood Control Project at Fremont, OH. Bedding and a manufactured fine aggregate for concrete also was produced for the Fremont Project. Core stone and 1-3 ton armor stone for the Pilot Dike Disposal Area (Dike No. 1), Cleveland, OH, was produced by this source.

A65. SANDUSKY CRUSHED STONE CO.

Quarry at Parkertown,OH, (Delaware Dolomite and Columbus Limestone). This source successfully produced 12 and 18-inch riprap for repairs to the Fremont Flood Control project. They produced cell fill material for the Huron Harbor, OH, Confined Diked Disposal Area. In addition, they furnished concrete aggregates for local ready-mix plants. Concrete placed at Huron Harbor Dike contains aggregates from this source.

A66. U. S. STEEL CORPORATION

Quarry at Cedarville, MI, (Engadine Formation) and quarry at Rogers City, MI, (Dundee and Rogers City Formation). Both sources contain loading facilities for self-unloading lake vessels. Rogers City quarry has furnished core stone material for the Diked Disposal Areas at Lorain Harbor, OH, and Cleveland Harbor, OH, (Dikes 2, 12, and 14). U. S. Steel has informed the Buffalo District that the maximum size material they will ship by vessel is six inches. Materials larger than six inches are of no interest to them.

A67. INLAND LIME AND STONE CO.

Quarry at Gulliver, MI, (Engadine Formation). This quarry also possesses loading facilities for self-unloading vessels. This source successfully produced cell fill material for the Huron Harbor, OH, Confined Diked Dredge Disposal Area.

A68. ERIE SAND AND GRAVEL, INC.

Erie, PA, (Dredged Lake Sand). Erie Sand and Gravel, Inc. has produced a fine aggregate for concrete for use at the Erie Harbor, PA, Confined Diked Dredge Disosal Area. However, recent test requests

indicate that this sand contains about 19 percent chert, six percent of which is potentially chemically reactive with cement. Therefore, low alkali cement is required if this sand is used for concrete.

A69. R. W. SIDLEY, INC.

Quarry at Thompson, OH, (Sharon Conglomerate). Fine aggregate from this source contains about 96 percent silica and four percent sandstone and siltstone. Concrete materials are supplied to local ready-mix plants.

A70. For some quarries, selective quarrying, loading, and handling will be required. This will affect production and might become a problem. Only two known sources possess grizzly equipment for the production of riprap, i.e., Standard Slag Co., Marblehead Stone Division at Marblehead, OH, and Sandusky Crushed Stone, Inc., at Parkertown, OH. The Woodville Lime and Chemical Co., at Woodville, OH, produces a 12-inch "Kiln Stone" for the steel industry. That material was used successfully for 12-inch riprap at Fremont, OH, Flood Control Project.

A71. Concrete aggregates are available from nearby ready-mix plants. Most of these plants obtain their aggregates from the northwestern sources via rail or self-unloading vessels.

A72. SUMMARY OF SOURCES

Armor Stone - Four suitable sources are available within 180 miles of the project.

Underlayer Stone - six suitable sources are available within 180 miles of the project.

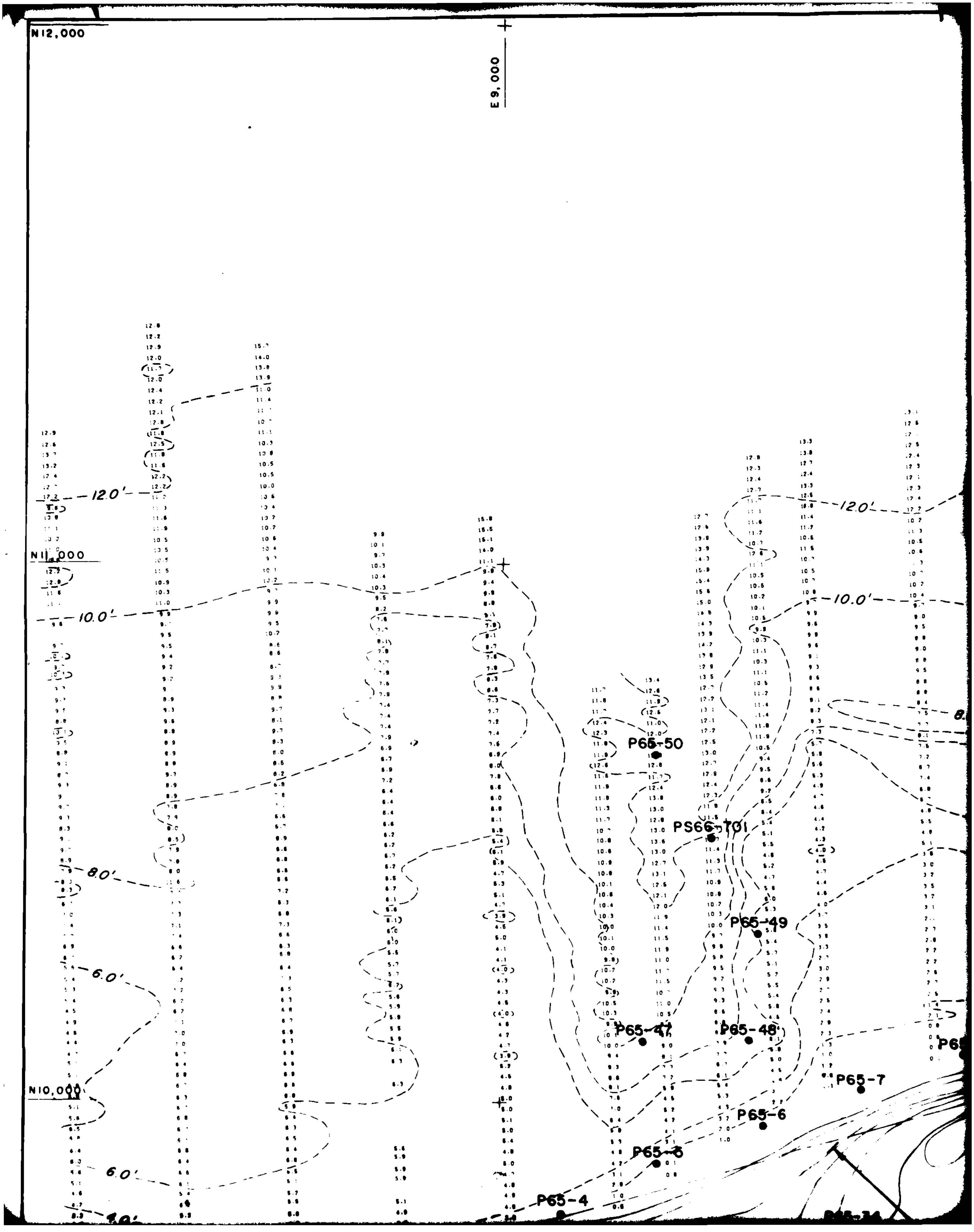
Core Stone - Six suitable sources are available within 380 miles of the project.

Riprap - Seven suitable sources are available within 150 miles of the project.

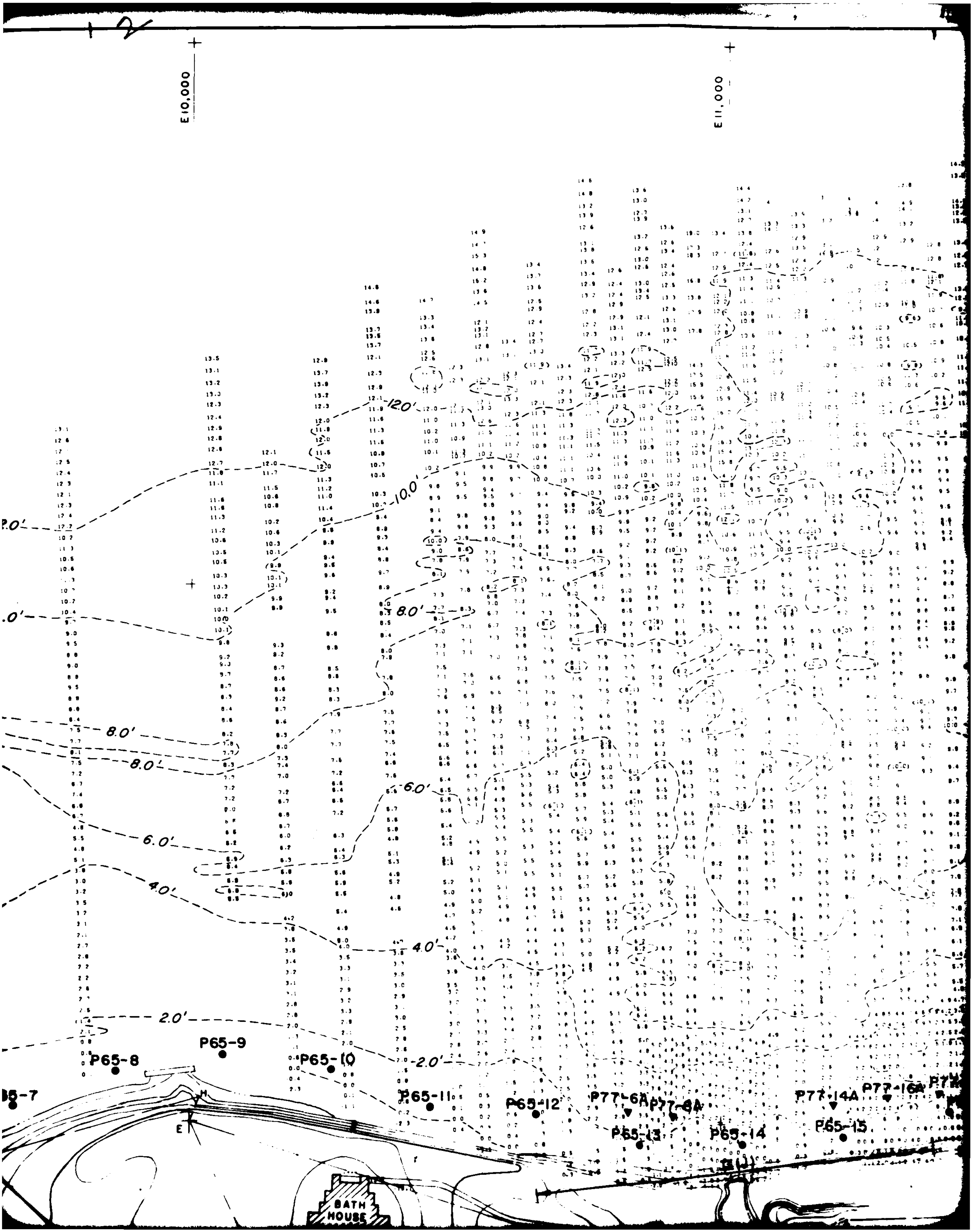
Bedding/Filter - Six suitable sources are available within 150 miles of the project.

Coarse Aggregates - Four suitable sources are available within 150 miles of the project.

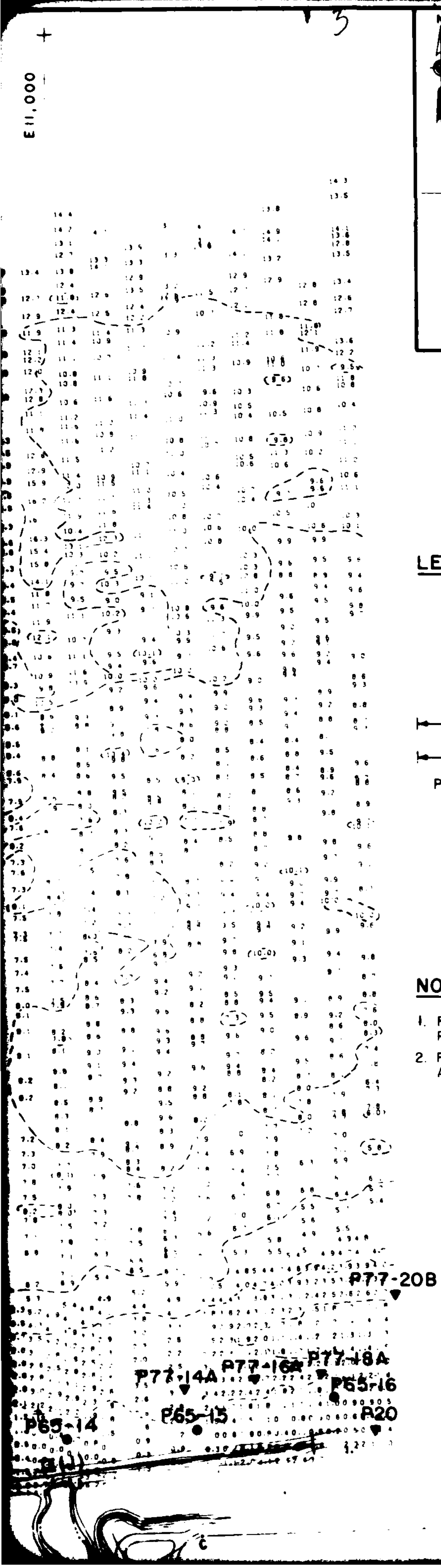
Fine Aggregates - Two suitable sources are available within 60 miles of the project.

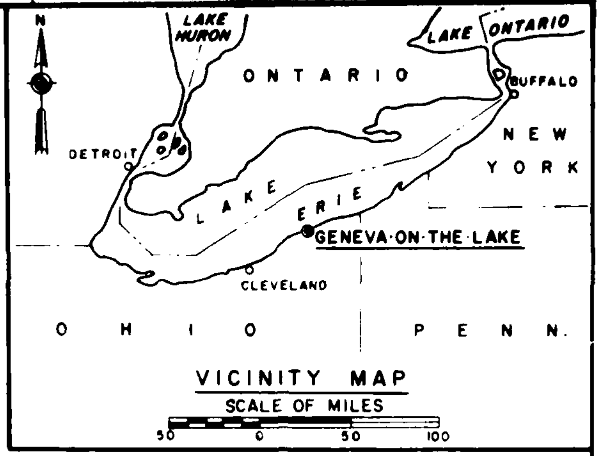


N12,000
E9,000
N11,000
N10,000
12.0'
10.0'
8.0'
6.0'
P65-50
PS66-T01
P65-49
P65-47
P65-48
P65-7
P65-6
P65-3
P65-4



E10,000
E11,000
12.0'
10.0'
8.0'
6.0'
4.0'
2.0'
P65-8
P65-9
P65-10
P65-11
P65-12
P65-13
P65-14
P65-15
P77-6A
P77-8A
P77-14A
P77-16A
BATH HOUSE




N12,000

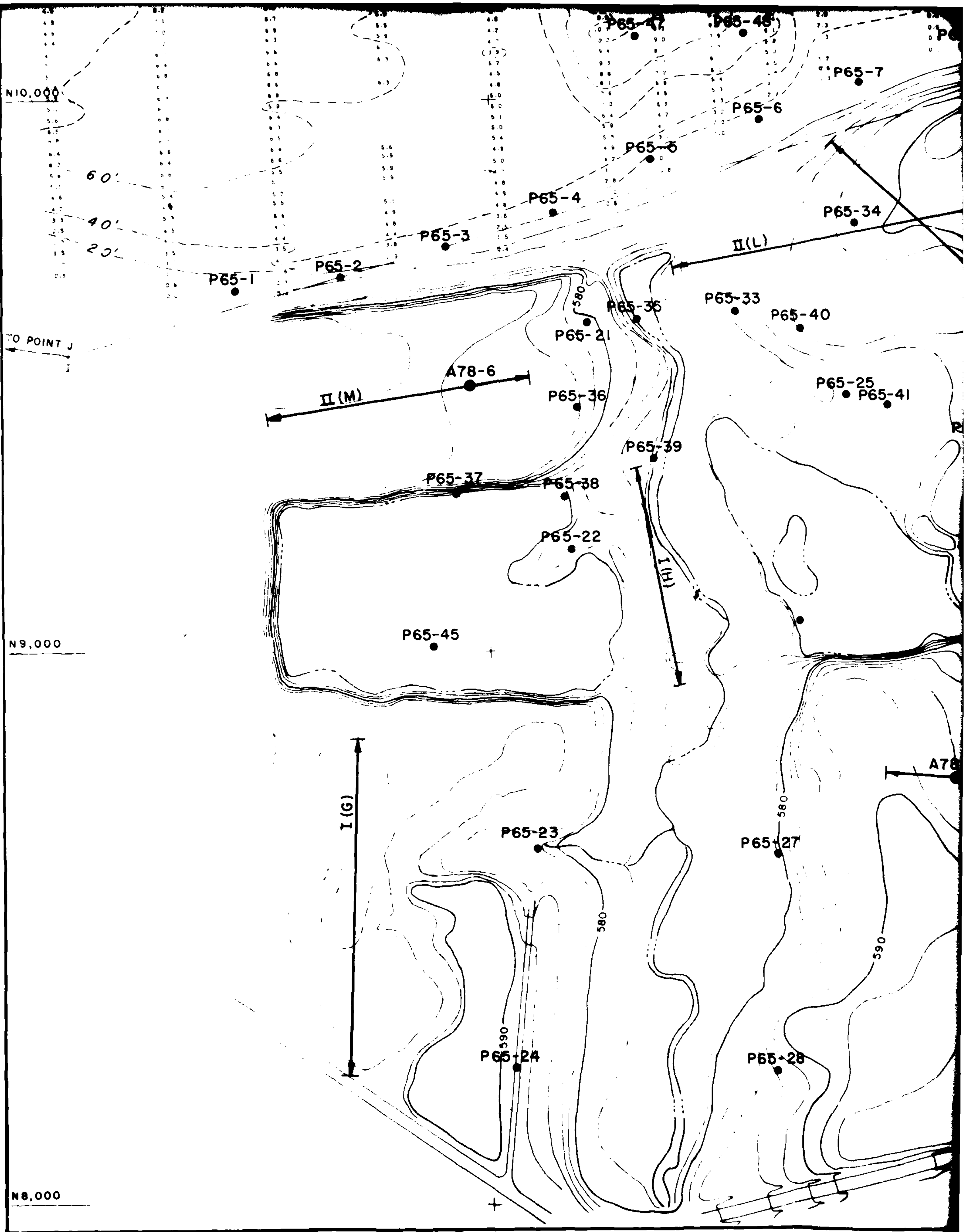
## LEGEND

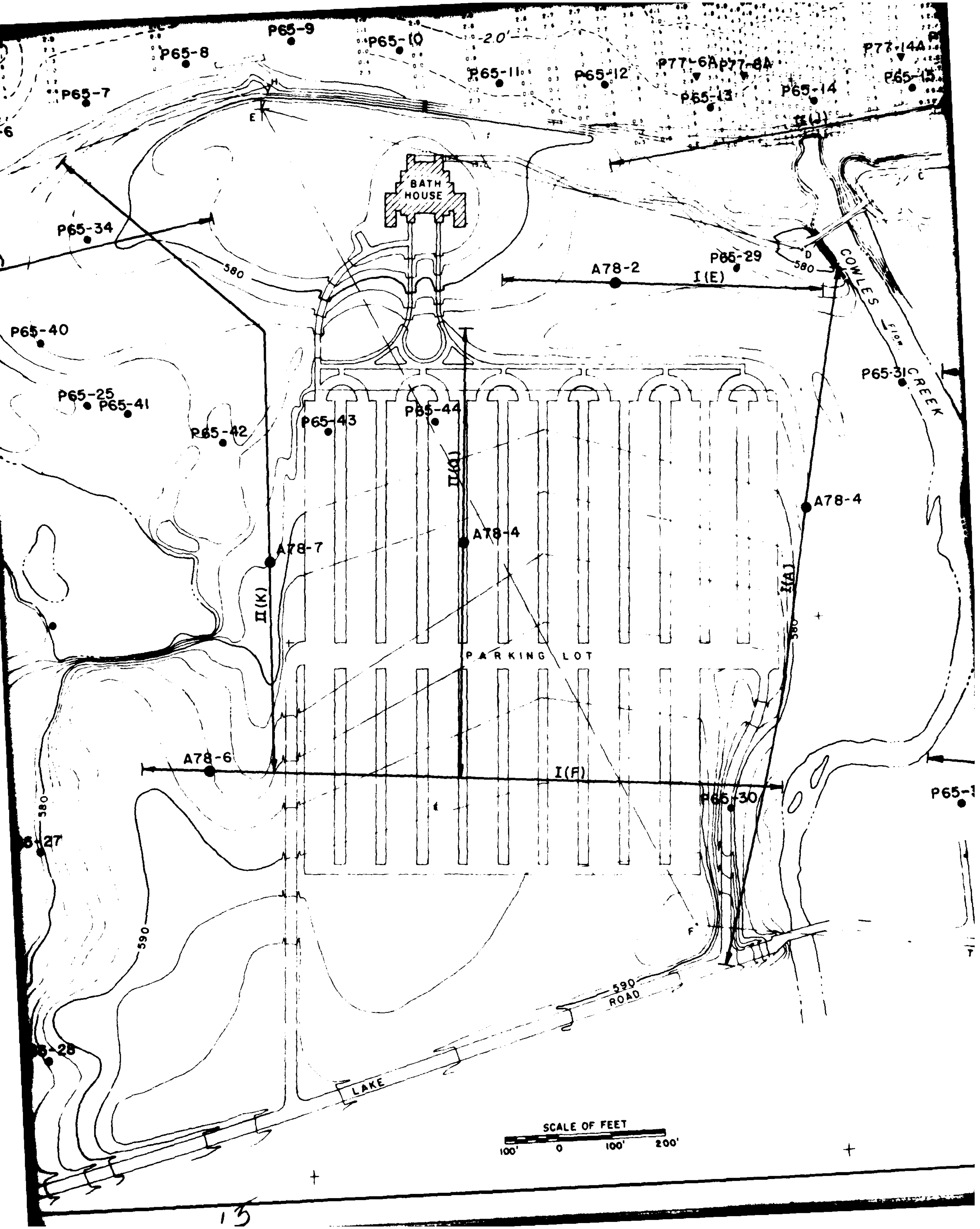
| | |
|---|---|
| P65-30 ● | 1965 PROBES |
| A78-7 ● | 1978 AUGER BORINGS |
| ▼ | 1977 PROBES |
| I (C) | SEISMIC LINE, PHASE I |
| II (Q) | SEISMIC LINE, PHASE II |
| PS66-701 | 1966 PORTER SAMPLER BORINGS |
| 7.1 | OFF SHORE SOUNDINGS (1977-1978) WITH INTERPRETED SUBSURFACE CONTOURS |

## NOTES:

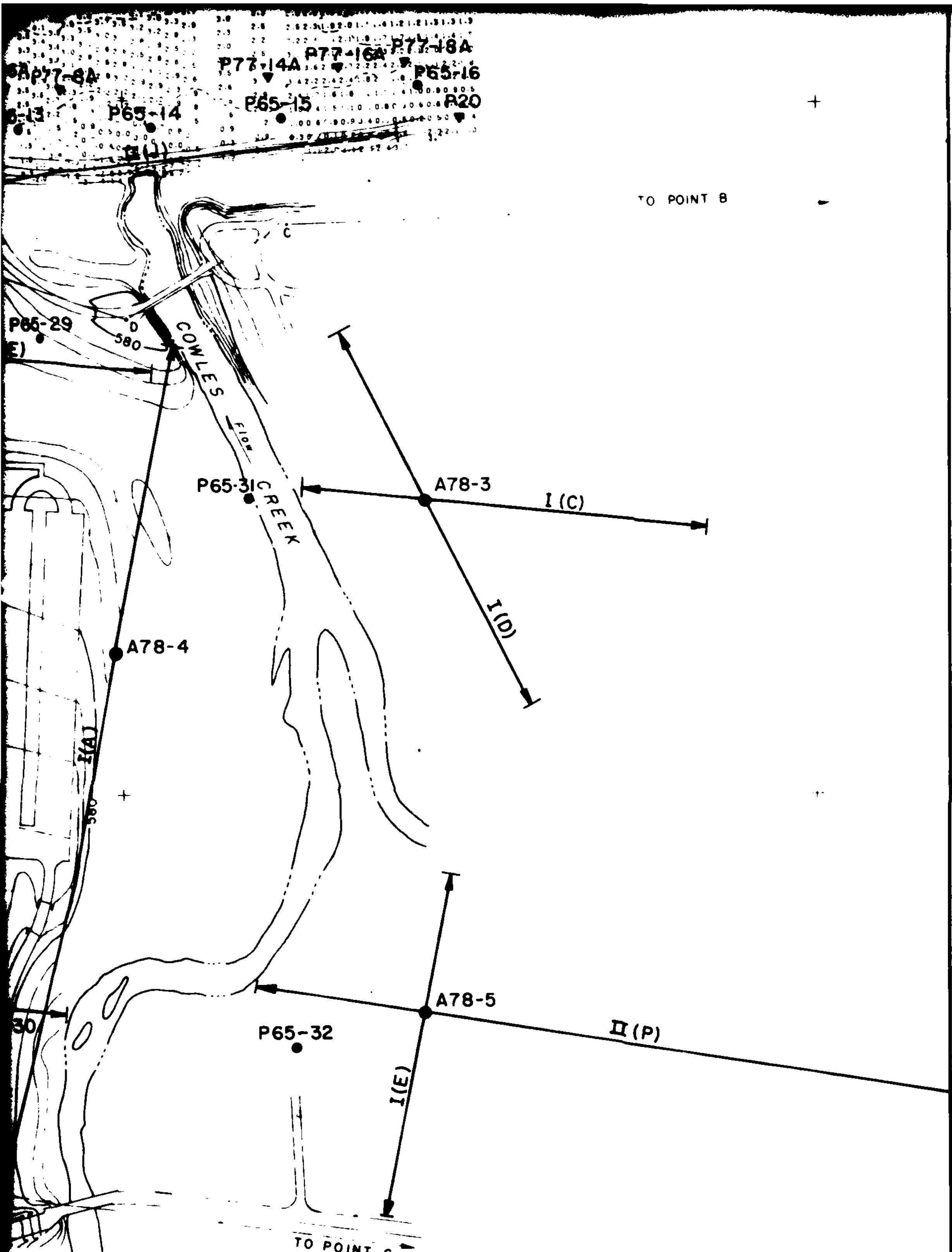
1. FOR LOCATIONS OF GEOLOGIC SECTIONS, SEE PLATES A4, A6, A8 AND A10.
2. FOR GEOLOGIC SECTIONS, SEE PLATES A5, A7, A9 AND A11.

TO POINT B


N10,000
N9,000
N8,000
TO POINT J
60'
40'
20'
P65-1
P65-2
P65-3
P65-4
P65-5
P65-6
P65-7
P65-47
P65-48
P65-34
II(L)
P65-33
P65-40
P65-35
P65-21
580
A78-6
II (M)
P65-36
P65-25
P65-41
P65-39
P65-37
P65-38
P65-22
I (H)
P65-45
I (G)
P65-23
P65-27
580
590
P65-24
P65-28
A78


P65-9
P65-10
P65-8
2.0'
P65-11
P65-12
P77-6A
P77-8A
P77-14A
P65-15
P65-7
P65-13
P65-14
II(J)
BATH HOUSE
P65-34
580
P65-29
A78-2
I(E)
COWLES CREEK
P65-40
P65-31
P65-25
P65-41
P65-43
P65-44
P65-42
II(G)
A78-4
A78-4
A78-7
II(K)
I(A)
PARKING LOT
A78-6
I(F)
P65-30
580
590
590
ROAD
LAKE
SCALE OF FEET
100' 0 100' 200'

13

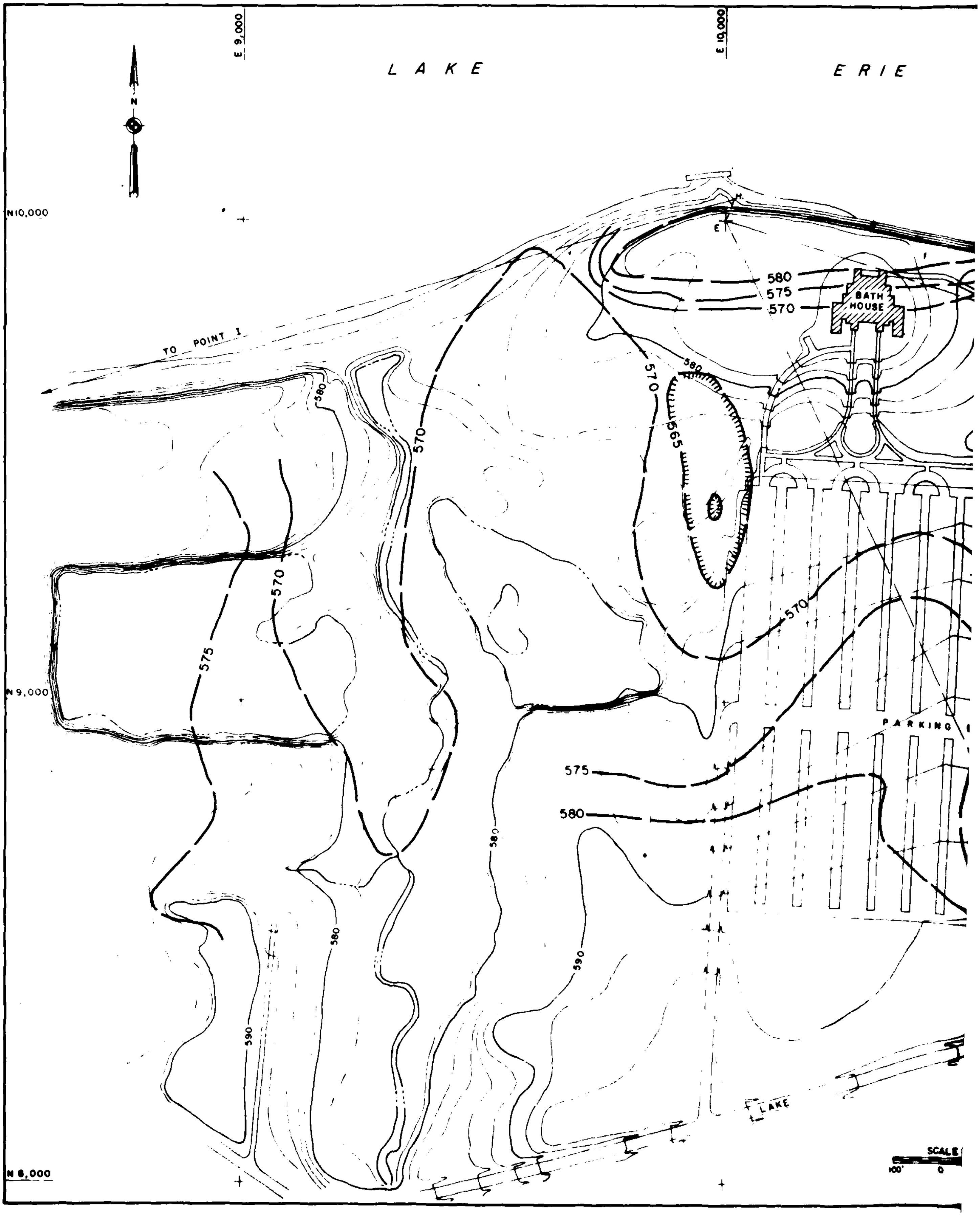


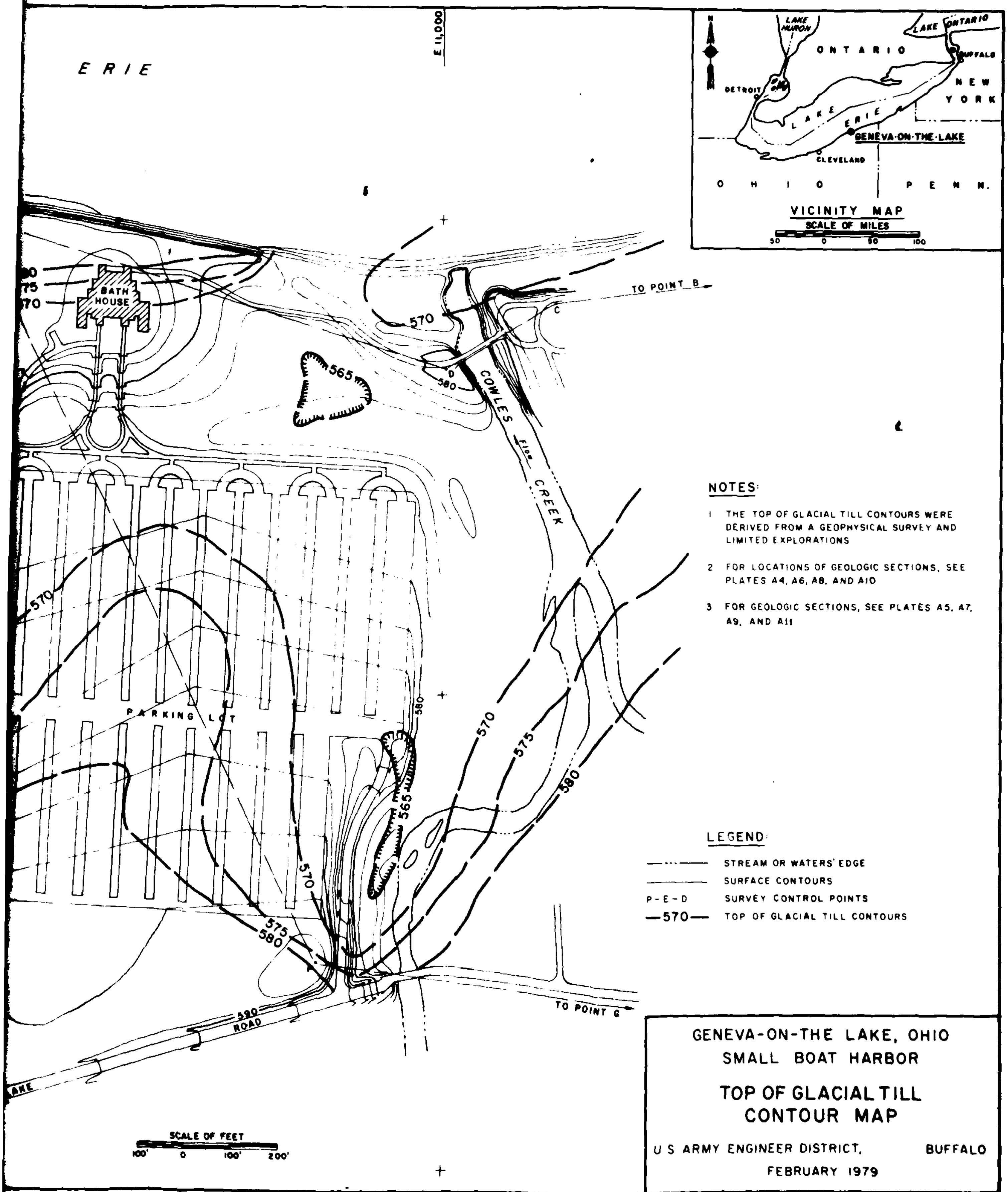

GENEVA-ON-THE-LAKE, OHIO
SMALL BOAT HARBOR

## PLAN OF SUBSURFACE INVESTIGATIONS

U.S. ARMY ENGINEER DISTRICT, BUFFALO

FEBRUARY 1979


E 9,000
E 10,000
L A K E
E R I E
N
N10,000
N 9,000
N 8,000
TO POINT I
580
575
570
BATH HOUSE
565
590
PARKING
LAKE
SCALE
100'
0




NOTES:

1. THE TOP OF GLACIAL TILL CONTOURS WERE DERIVED FROM A GEOPHYSICAL SURVEY AND LIMITED EXPLORATIONS
2. FOR LOCATIONS OF GEOLOGIC SECTIONS, SEE PLATES A4, A6, A8, AND A10
3. FOR GEOLOGIC SECTIONS, SEE PLATES A5, A7, A9, AND A11

LEGEND:

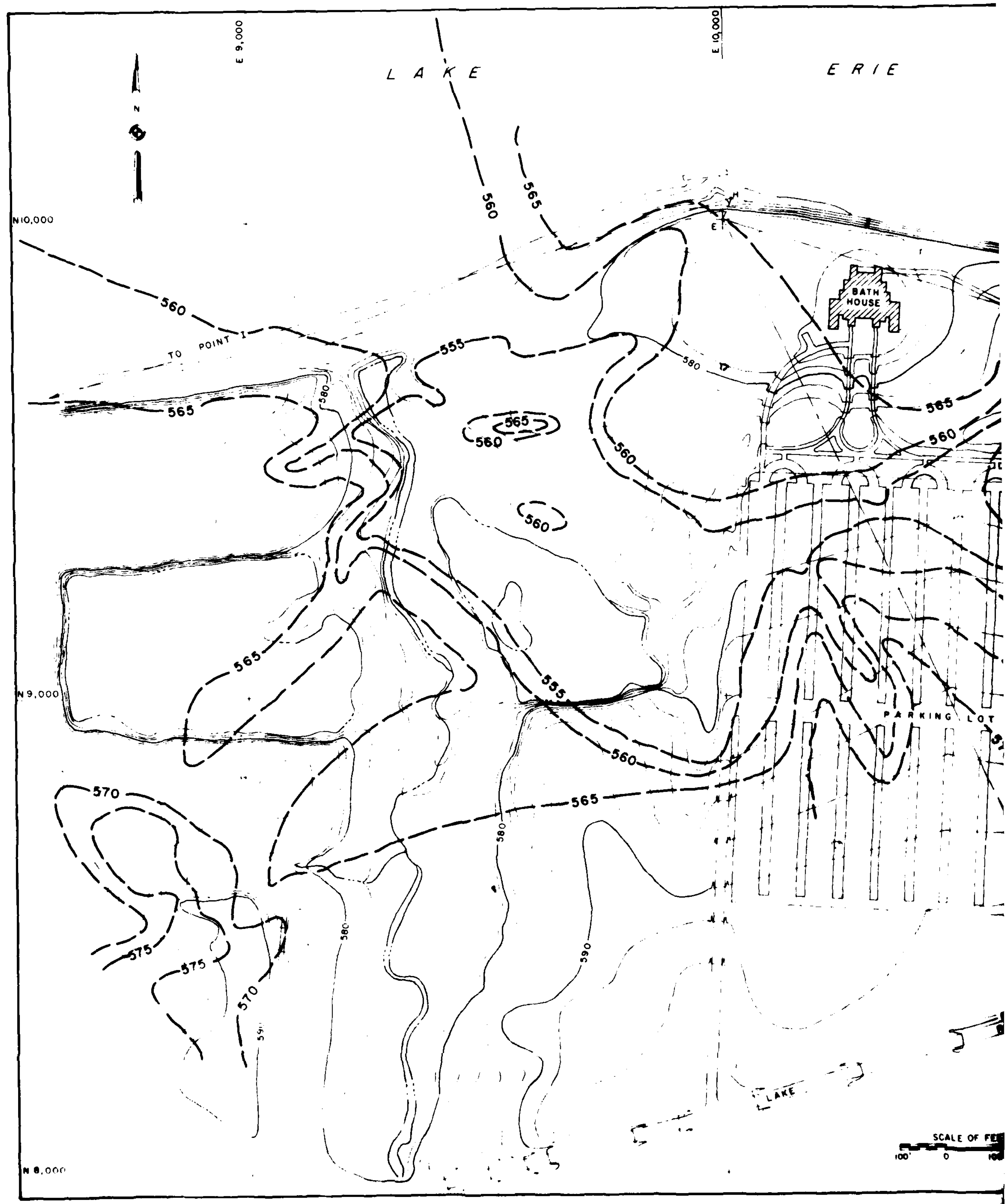
| | |
|---|---|
| —··—··— | STREAM OR WATERS' EDGE |
| ———— | SURFACE CONTOURS |
| P – E – D | SURVEY CONTROL POINTS |
| —570— | TOP OF GLACIAL TILL CONTOURS |

GENEVA-ON-THE LAKE, OHIO
SMALL BOAT HARBOR

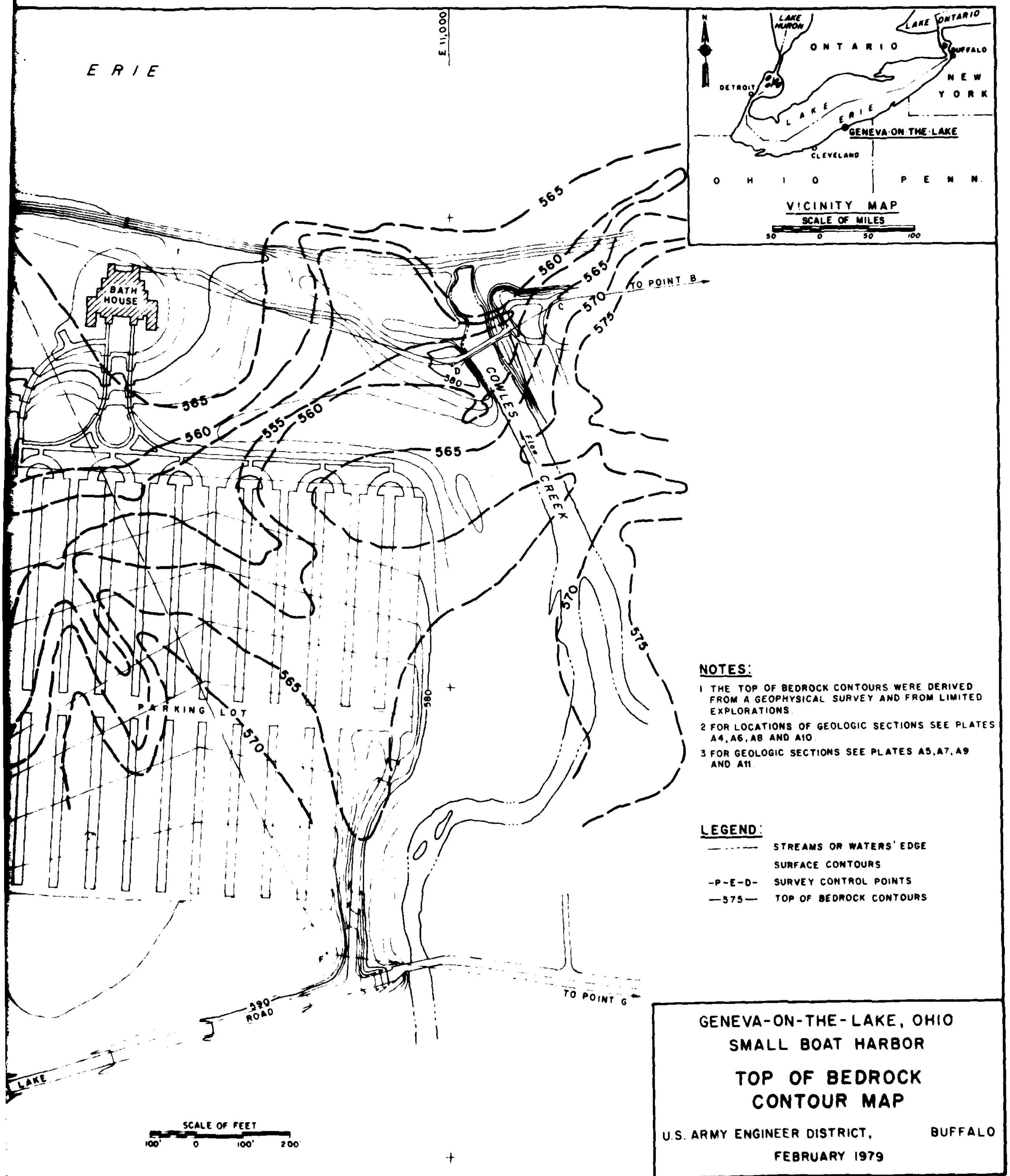
## TOP OF GLACIAL TILL CONTOUR MAP

U S ARMY ENGINEER DISTRICT, BUFFALO
FEBRUARY 1979

PLATE A2



E 9,000
E 10,000
L A K E
E R I E
N
N10,000
N 9,000
N 8,000
TO POINT I
BATH HOUSE
PARKING LOT
LAKE
555
560
565
570
575
580
590
SCALE OF FEE
100' 0




**NOTES:**

1. THE TOP OF BEDROCK CONTOURS WERE DERIVED FROM A GEOPHYSICAL SURVEY AND FROM LIMITED EXPLORATIONS.
2. FOR LOCATIONS OF GEOLOGIC SECTIONS SEE PLATES A4, A6, A8 AND A10.
3. FOR GEOLOGIC SECTIONS SEE PLATES A5, A7, A9 AND A11.

**LEGEND:**

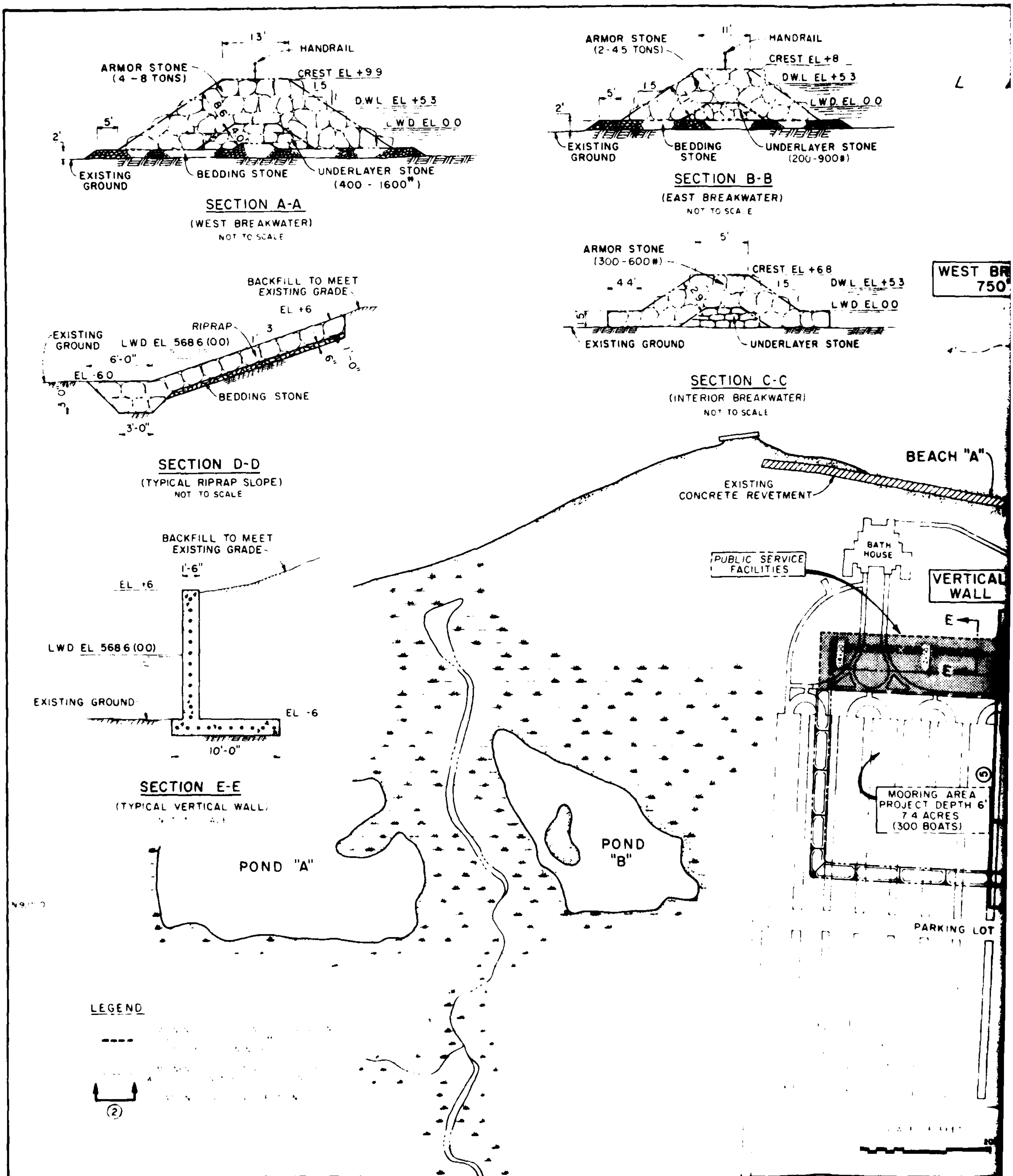
| | |
|---|---|
| ——-·-·- | STREAMS OR WATERS' EDGE |
| | SURFACE CONTOURS |
| -P-E-D- | SURVEY CONTROL POINTS |
| —575— | TOP OF BEDROCK CONTOURS |

GENEVA-ON-THE-LAKE, OHIO
SMALL BOAT HARBOR

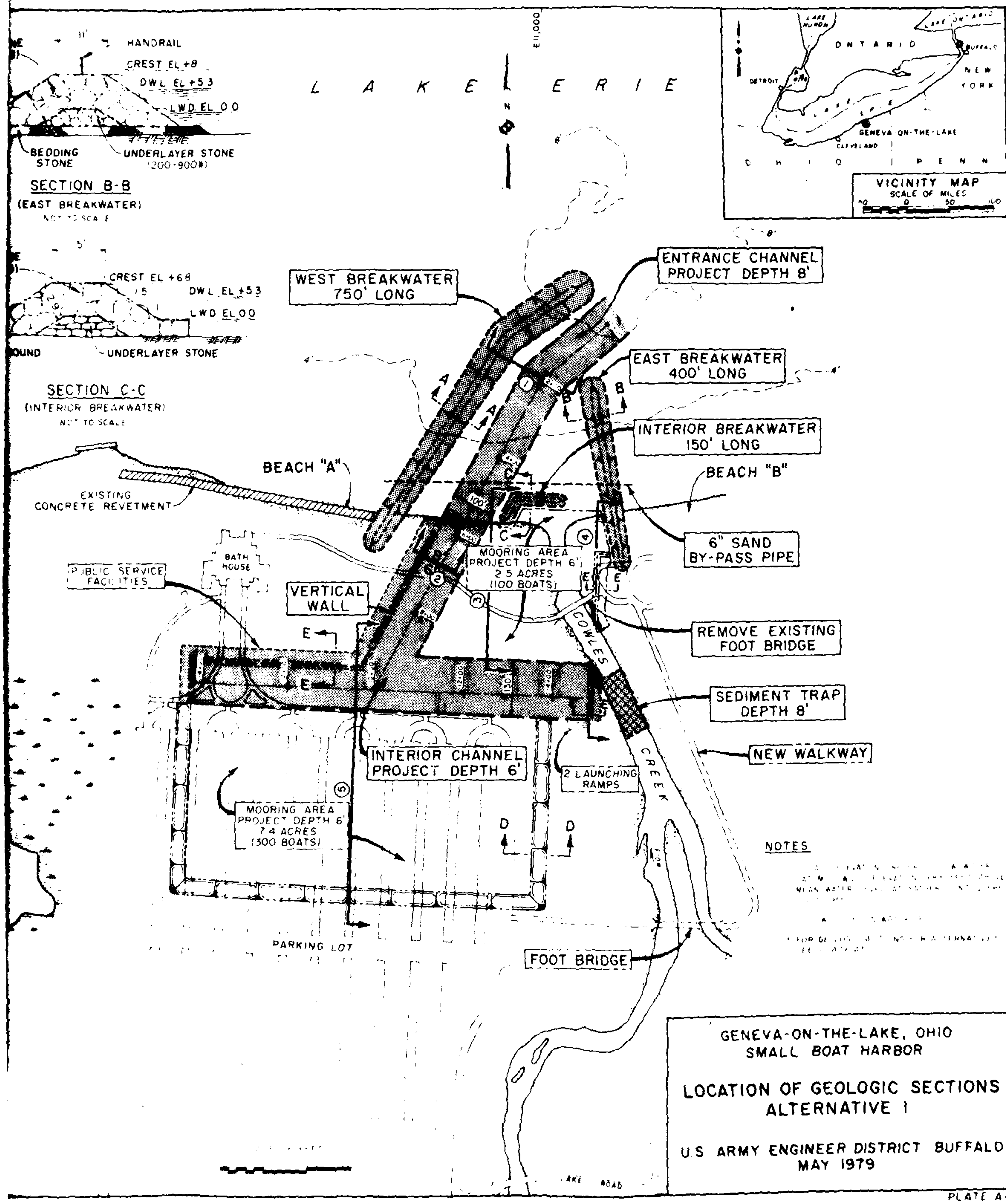
**TOP OF BEDROCK CONTOUR MAP**

U.S. ARMY ENGINEER DISTRICT, BUFFALO
FEBRUARY 1979

PLATE A3



13'
HANDRAIL
ARMOR STONE (4 - 8 TONS)
CREST EL +9.9
1.5
1'
D.W.L. EL +5.3
LWD EL 0.0
5'
2'
EXISTING GROUND
BEDDING STONE
UNDERLAYER STONE (400 - 1600#)
SECTION A-A
(WEST BREAKWATER)
NOT TO SCALE
ARMOR STONE (2-4.5 TONS)
11'
HANDRAIL
CREST EL +8
D.W.L. EL +5.3
LWD EL 0.0
5'
1.5
2'
EXISTING GROUND
BEDDING STONE
UNDERLAYER STONE (200-900#)
SECTION B-B
(EAST BREAKWATER)
NOT TO SCALE
ARMOR STONE (300-600#)
5'
CREST EL +6.8
4.4'
1.5
DWL EL +5.3
LWD EL 0.0
1.5'
EXISTING GROUND
UNDERLAYER STONE
SECTION C-C
(INTERIOR BREAKWATER)
NOT TO SCALE
BACKFILL TO MEET EXISTING GRADE
EL +6
RIPRAP
3
EXISTING GROUND
LWD EL 568.6 (0.0)
6'-0"
EL -6.0
6"
1'-0"
3'-0"
BEDDING STONE
3'-0"
SECTION D-D
(TYPICAL RIPRAP SLOPE)
NOT TO SCALE
BACKFILL TO MEET EXISTING GRADE
1'-6"
EL +6
LWD EL 568.6 (0.0)
EXISTING GROUND
EL -6
10'-0"
SECTION E-E
(TYPICAL VERTICAL WALL)
WEST BR
750'
BEACH "A"
EXISTING CONCRETE REVETMENT
BATH HOUSE
PUBLIC SERVICE FACILITIES
VERTICAL WALL
E
E
MOORING AREA
PROJECT DEPTH 6'
7.4 ACRES
(300 BOATS)
5
POND "A"
POND "B"
PARKING LOT
LEGEND
2

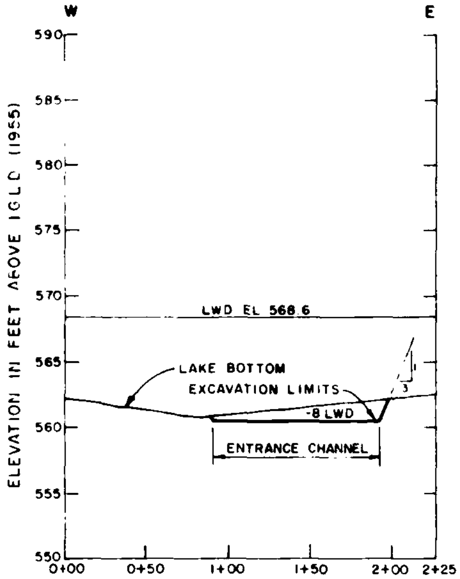



GENEVA-ON-THE-LAKE, OHIO
SMALL BOAT HARBOR

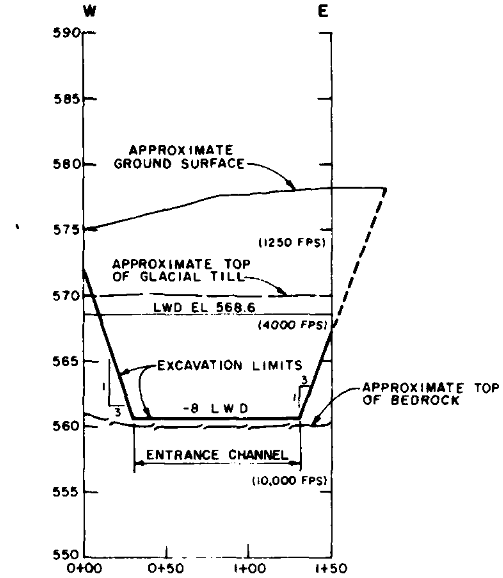
LOCATION OF GEOLOGIC SECTIONS
ALTERNATIVE 1

U.S. ARMY ENGINEER DISTRICT BUFFALO
MAY 1979

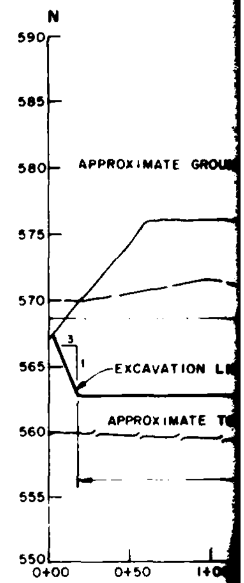
PLATE A4



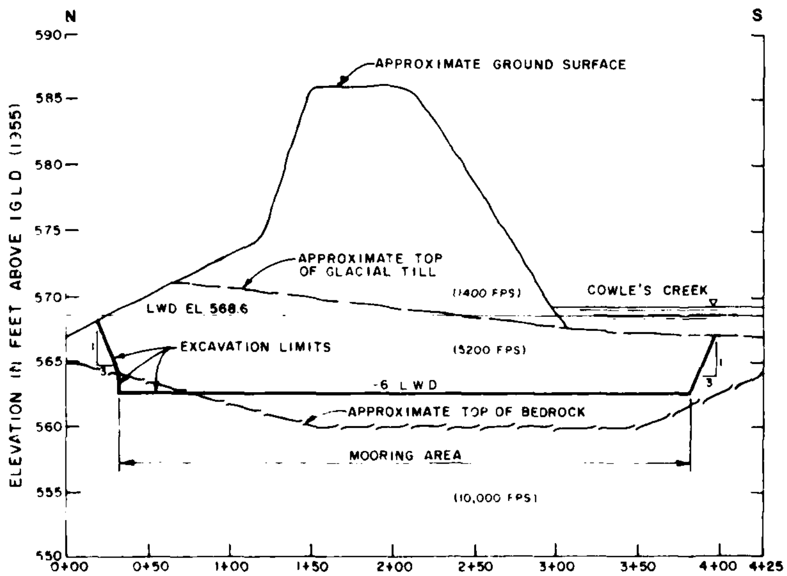

GEOLOGIC SECTION ① STA. 1+95



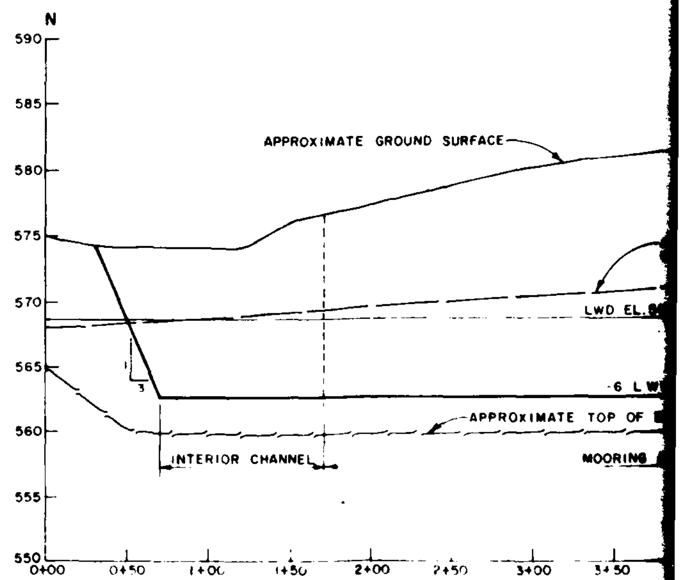

GEOLOGIC SECTION ② STA. 6+80




GEOLO

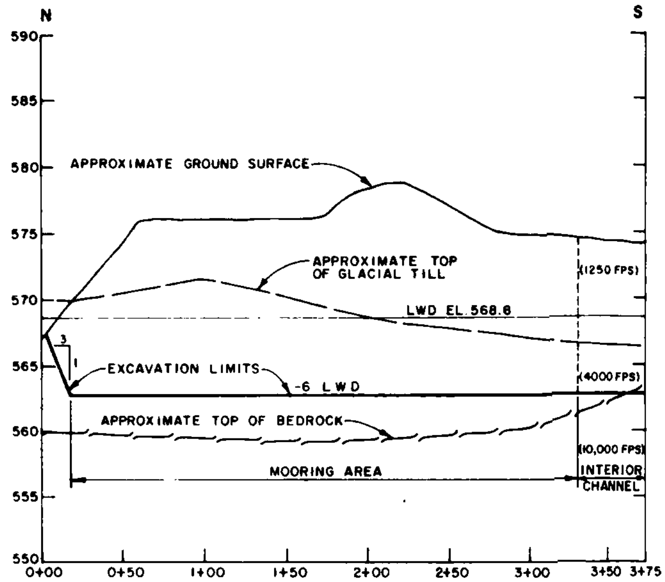



GEOLOGIC SECTION ④ STA. 5+05 I

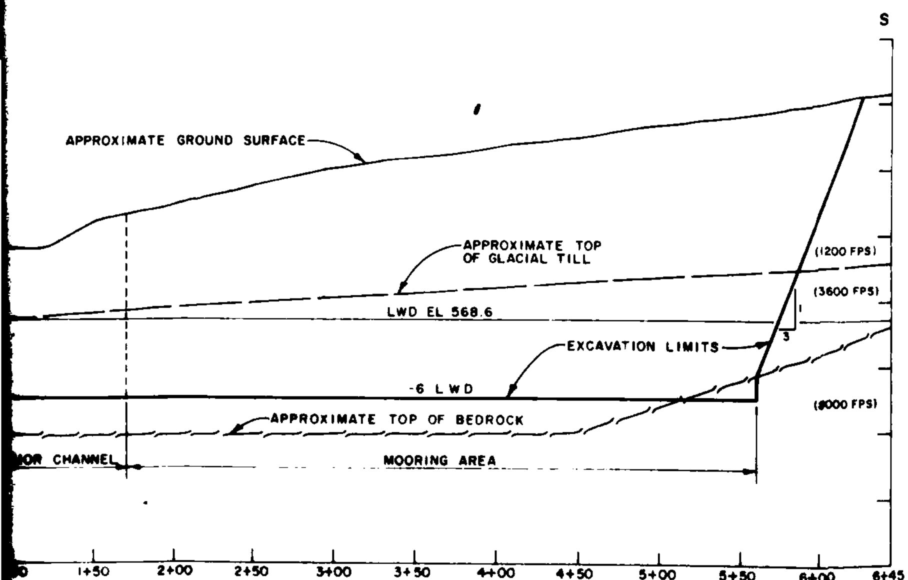



GEOLOGIC SECTION ⑤ ST


80




GEOLOGIC SECTION ③ STA. 7+45 I




GEOLOGIC SECTION ⑤ STA. 10+35

NOTES:

1. FOR LOCATION OF GEOLOGIC SECTIONS, SEE PLATE A4
2. FPS INDICATES VELOCITIES FROM SEISMIC SURVEY

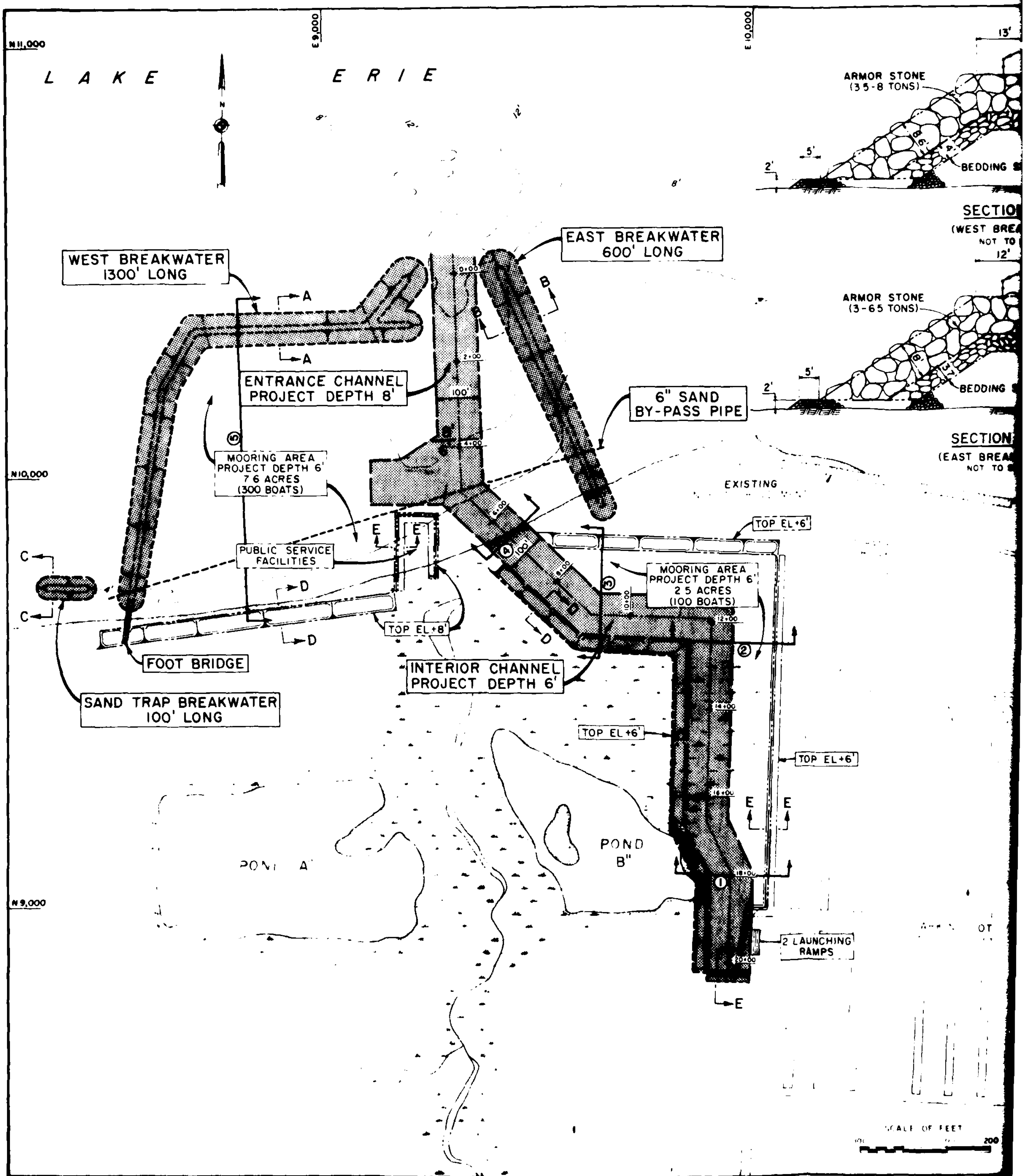
GENEVA-ON-THE-LAKE, OHIO
SMALL BOAT HARBOR

GEOLOGIC SECTIONS
ALTERNATIVE 1

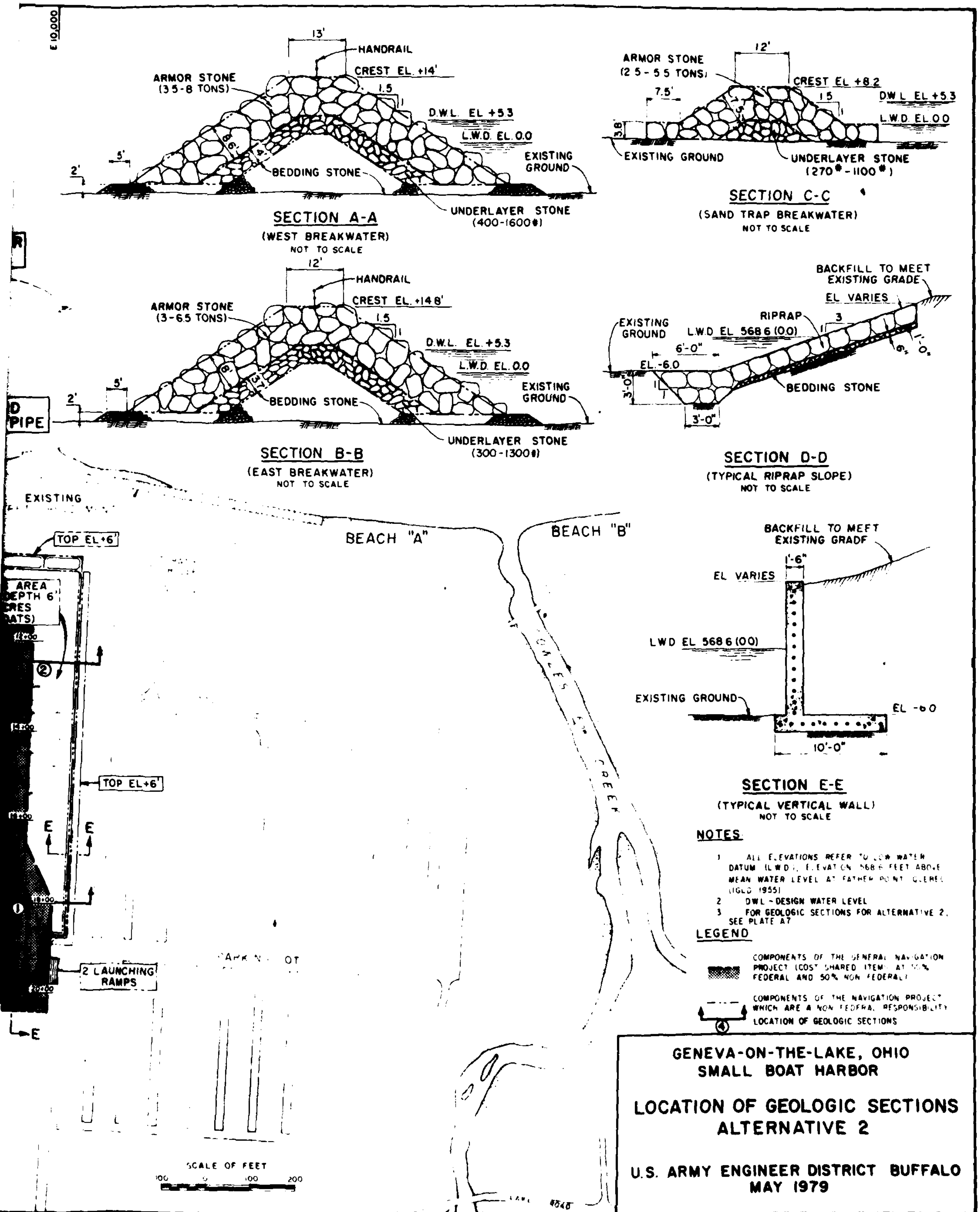
U.S. ARMY ENGINEER DISTRICT BUFFALO
MAY 1979



2



LAKE ERIE
N 11,000
E 9,000
E 10,000
N 10,000
N 9,000
WEST BREAKWATER 1300' LONG
EAST BREAKWATER 600' LONG
ENTRANCE CHANNEL PROJECT DEPTH 8'
6" SAND BY-PASS PIPE
MOORING AREA PROJECT DEPTH 6' 7.6 ACRES (300 BOATS)
PUBLIC SERVICE FACILITIES
MOORING AREA PROJECT DEPTH 6' 2.5 ACRES (100 BOATS)
TOP EL +6'
TOP EL +8'
FOOT BRIDGE
INTERIOR CHANNEL PROJECT DEPTH 6'
SAND TRAP BREAKWATER 100' LONG
EXISTING
POND B"
2 LAUNCHING RAMPS
ARMOR STONE (3.5-8 TONS)
BEDDING
SECTION
(WEST BREA
ARMOR STONE (3-6.5 TONS)
SECTION
(EAST BREA
SCALE OF FEET
200




NOTES

1. ALL ELEVATIONS REFER TO LOW WATER DATUM (L.W.D.), ELEVATION 568.6 FEET ABOVE MEAN WATER LEVEL AT FATHER POINT, QUEBEC (IGLD 1955)
2. DWL - DESIGN WATER LEVEL
3. FOR GEOLOGIC SECTIONS FOR ALTERNATIVE 2, SEE PLATE A7

LEGEND

COMPONENTS OF THE GENERAL NAVIGATION PROJECT (COST SHARED ITEMS AT 50% FEDERAL AND 50% NON FEDERAL)

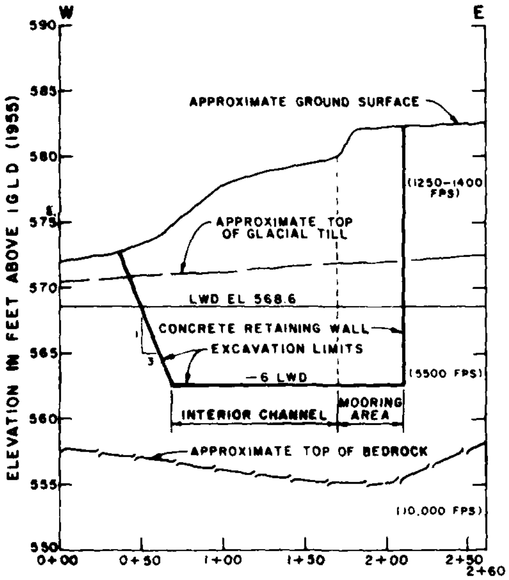
COMPONENTS OF THE NAVIGATION PROJECT WHICH ARE A NON FEDERAL RESPONSIBILITY

LOCATION OF GEOLOGIC SECTIONS

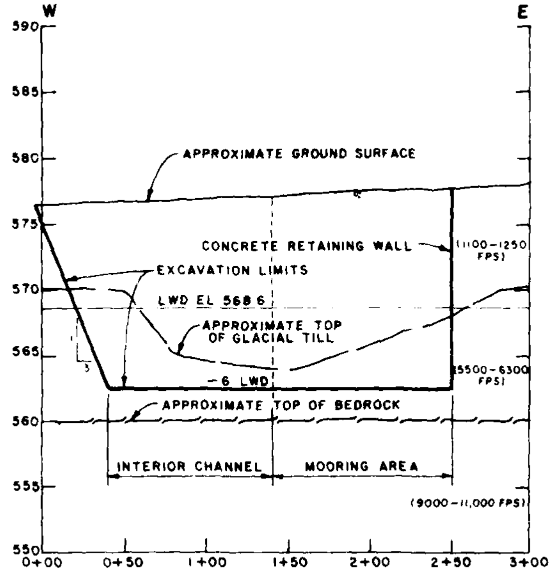
GENEVA-ON-THE-LAKE, OHIO
SMALL BOAT HARBOR

LOCATION OF GEOLOGIC SECTIONS
ALTERNATIVE 2

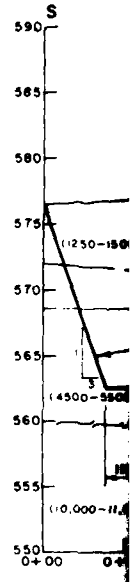
U.S. ARMY ENGINEER DISTRICT BUFFALO
MAY 1979



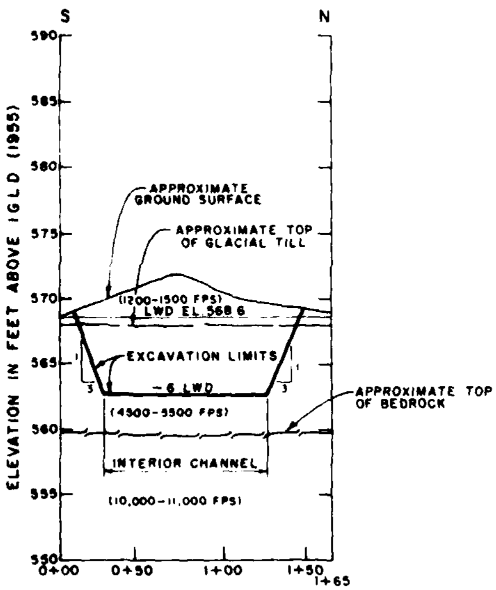

GEOLOGIC SECTION ① STA.17+97



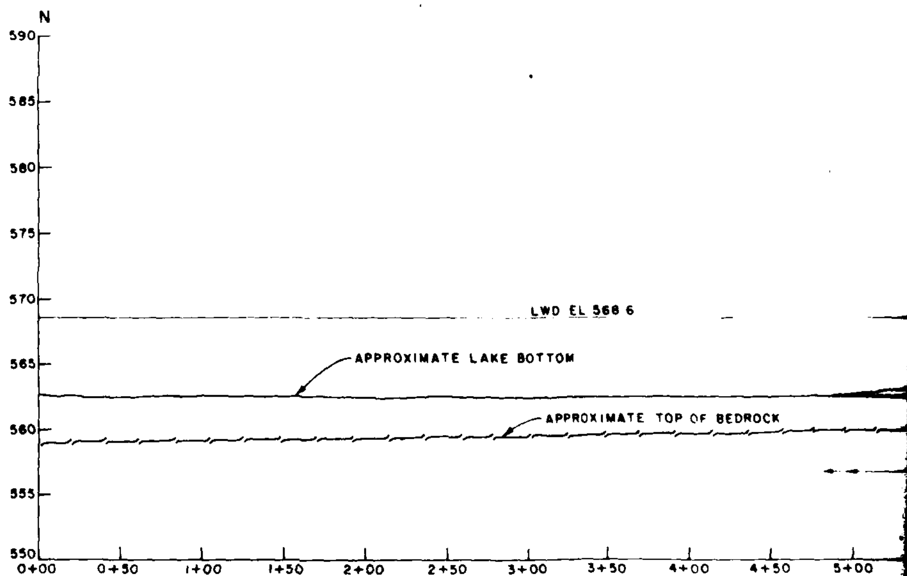

GEOLOGIC SECTION ② STA.12+45



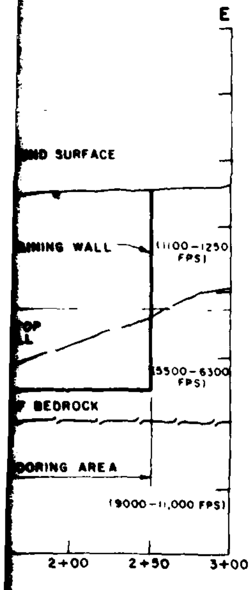

GE



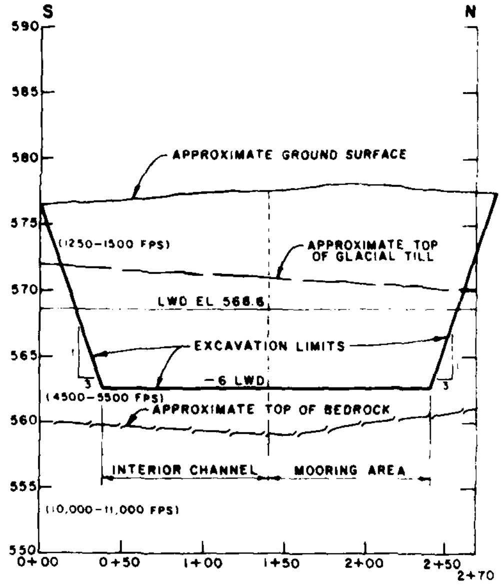

GEOLOGIC SECTION ④ STA. 6+60



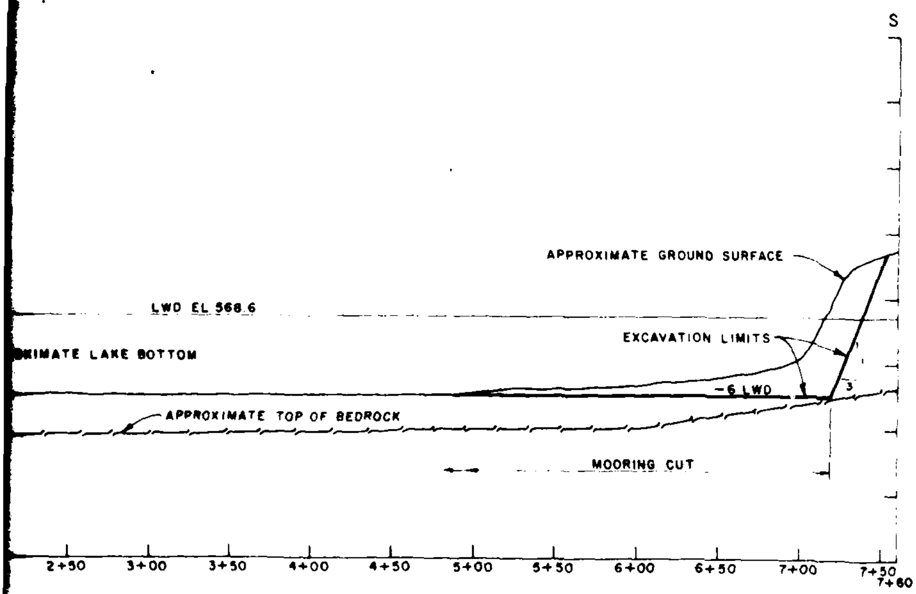

GEOLOGIC SECTION ⑤ STA. 4+50 W




② STA. 12+45




GEOLOGIC SECTION ③ STA. 9+30




GEOLOGIC SECTION ⑤ STA. 4+50 W

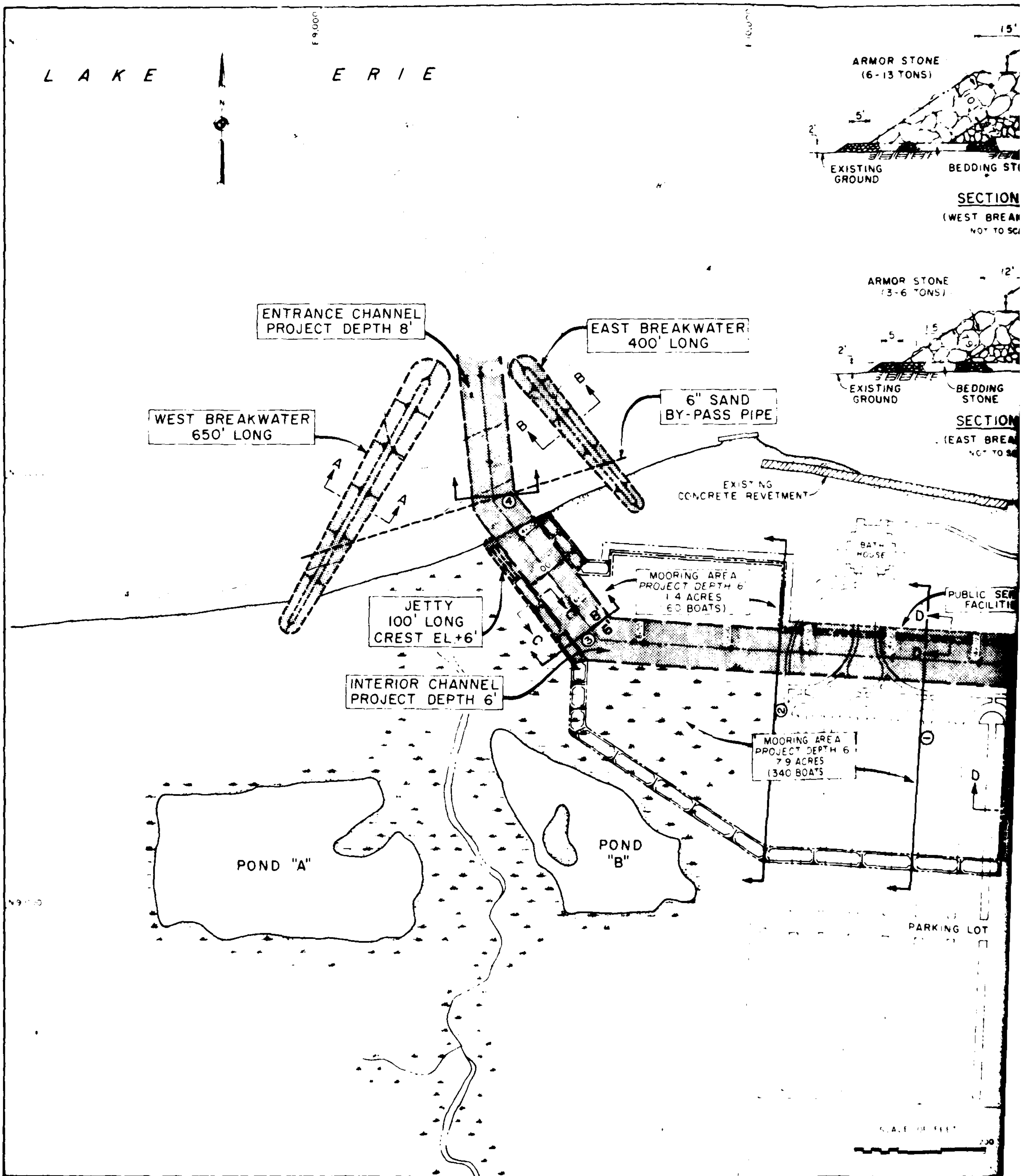
NOTES:

1 FOR LOCATIONS OF GEOLOGIC SECTIONS SEE PLATE A6.
2 FPS INDICATES VELOCITIES FROM SEISMIC SURVEY.

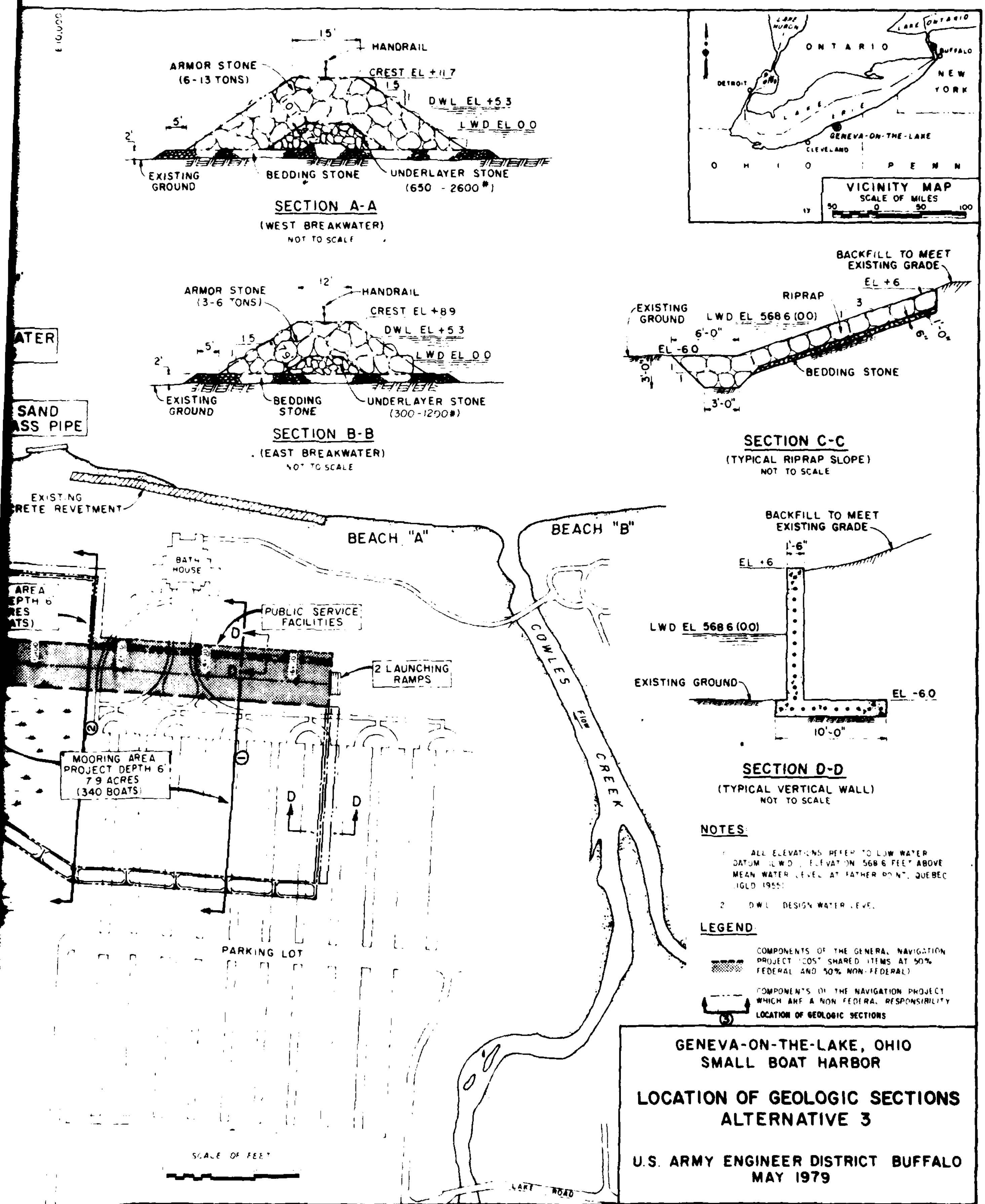
GENEVA-ON-THE-LAKE, OHIO
SMALL BOAT HARBOR

**GEOLOGIC SECTIONS**
**ALTERNATIVE 2**

U S ARMY ENGINEER DISTRICT BUFFALO
MAY 1979



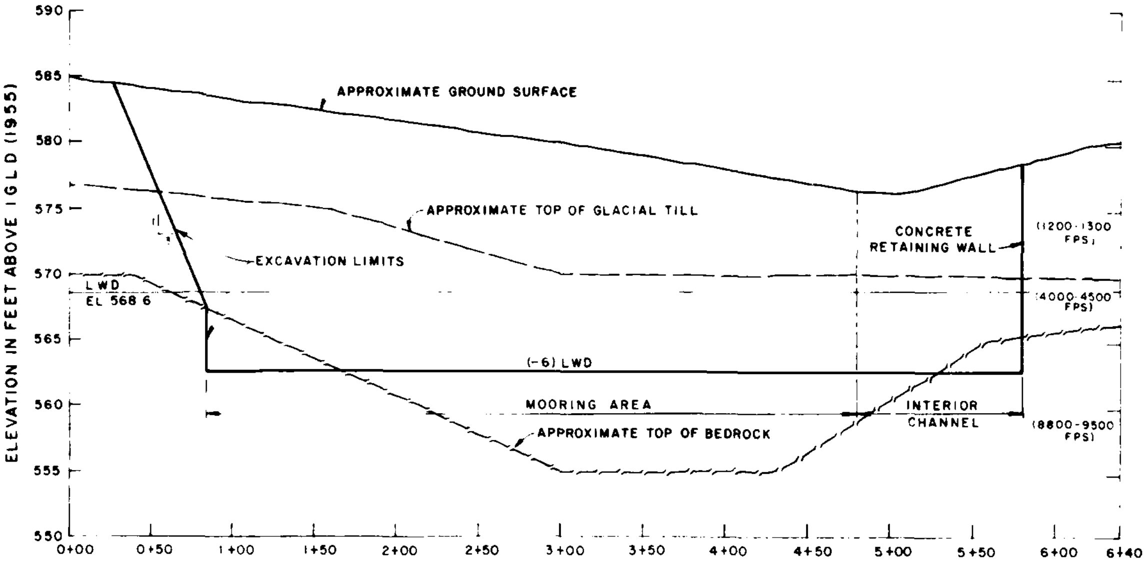
LAKE ERIE
ARMOR STONE (6-13 TONS)
EXISTING GROUND
SECTION
ARMOR STONE (3-6 TONS)
EXISTING GROUND
BEDDING STONE
SECTION
ENTRANCE CHANNEL PROJECT DEPTH 8'
EAST BREAKWATER 400' LONG
6" SAND BY-PASS PIPE
WEST BREAKWATER 650' LONG
EXISTING CONCRETE REVETMENT
MOORING AREA PROJECT DEPTH 6' 1.4 ACRES (60 BOATS)
JETTY 100' LONG CREST EL +6'
INTERIOR CHANNEL PROJECT DEPTH 6'
MOORING AREA PROJECT DEPTH 6 7.9 ACRES (340 BOATS)
POND "A"
POND "B"
PARKING LOT



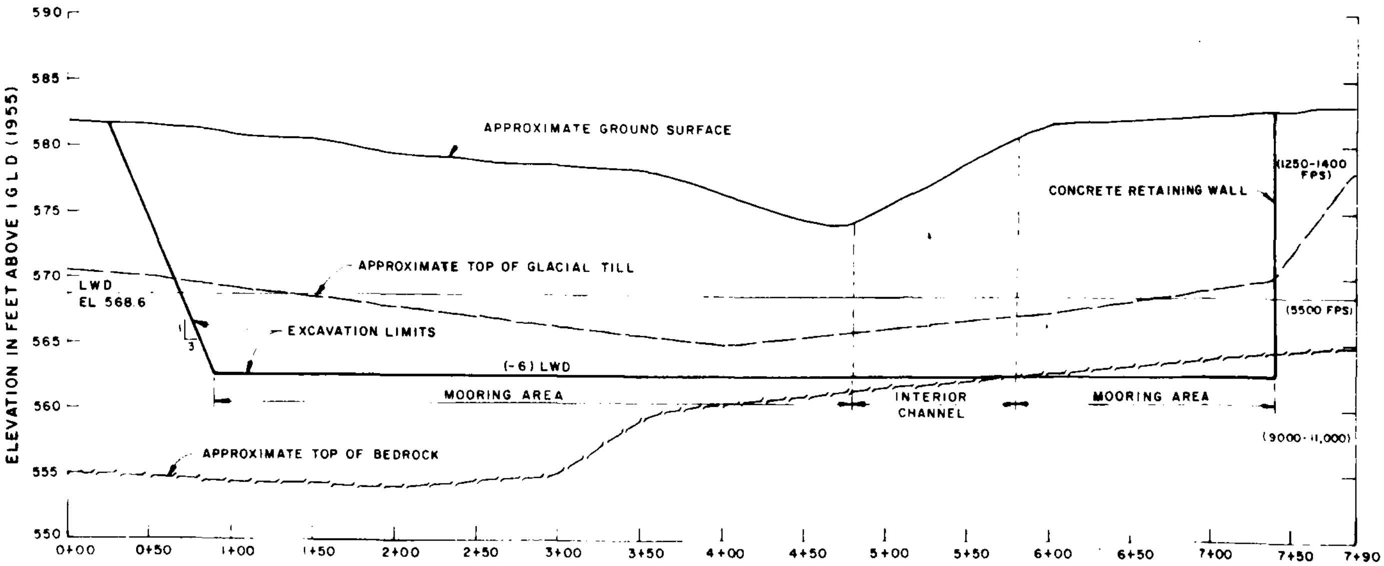
HANDRAIL
ARMOR STONE (6-13 TONS)
CREST EL +11.7
DWL EL +5.3
LWD EL 0.0
EXISTING GROUND
BEDDING STONE
UNDERLAYER STONE (650 - 2600#)
SECTION A-A
(WEST BREAKWATER)
NOT TO SCALE
ARMOR STONE (3-6 TONS)
HANDRAIL
CREST EL +8.9
DWL EL +5.3
LWD EL 0.0
EXISTING GROUND
BEDDING STONE
UNDERLAYER STONE (300-1200#)
SECTION B-B
(EAST BREAKWATER)
NOT TO SCALE
VICINITY MAP
SCALE OF MILES
ONTARIO
LAKE HURON
LAKE ONTARIO
BUFFALO
NEW YORK
DETROIT
LAKE ERIE
GENEVA-ON-THE-LAKE
CLEVELAND
OHIO
PENN
BACKFILL TO MEET EXISTING GRADE
EL +6
RIPRAP
EXISTING GROUND
LWD EL 568.6 (0.0)
EL -6.0
BEDDING STONE
SECTION C-C
(TYPICAL RIPRAP SLOPE)
NOT TO SCALE
BACKFILL TO MEET EXISTING GRADE
EL +6
LWD EL 568.6 (0.0)
EXISTING GROUND
EL -6.0
SECTION D-D
(TYPICAL VERTICAL WALL)
NOT TO SCALE
SAND BYPASS PIPE
EXISTING CONCRETE REVETMENT
BEACH "A"
BEACH "B"
BATH HOUSE
PUBLIC SERVICE FACILITIES
2 LAUNCHING RAMPS
MOORING AREA PROJECT DEPTH 6' 7.9 ACRES (340 BOATS)
COWLES CREEK
FLOW
PARKING LOT
LAKE ROAD
SCALE OF FEET
NOTES:
1. ALL ELEVATIONS REFER TO LOW WATER DATUM (LWD), ELEVATION 568.6 FEET ABOVE MEAN WATER LEVEL AT FATHER POINT, QUEBEC (IGLD 1955).
2. DWL - DESIGN WATER LEVEL.
LEGEND:
COMPONENTS OF THE GENERAL NAVIGATION PROJECT (COST SHARED ITEMS AT 50% FEDERAL AND 50% NON-FEDERAL)
COMPONENTS OF THE NAVIGATION PROJECT WHICH ARE A NON FEDERAL RESPONSIBILITY
LOCATION OF GEOLOGIC SECTIONS
GENEVA-ON-THE-LAKE, OHIO
SMALL BOAT HARBOR
LOCATION OF GEOLOGIC SECTIONS
ALTERNATIVE 3
U.S. ARMY ENGINEER DISTRICT BUFFALO
MAY 1979



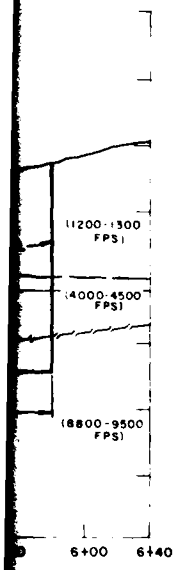

12

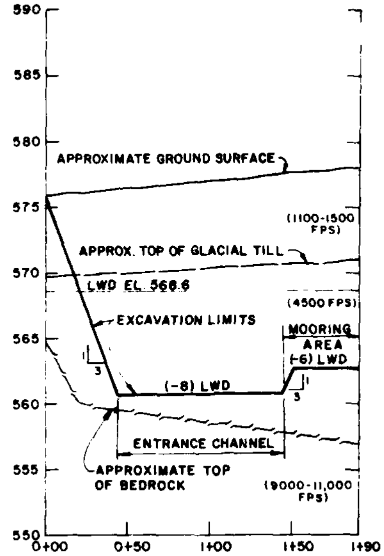



GEOLOGIC SECTION ① STA. 14+65

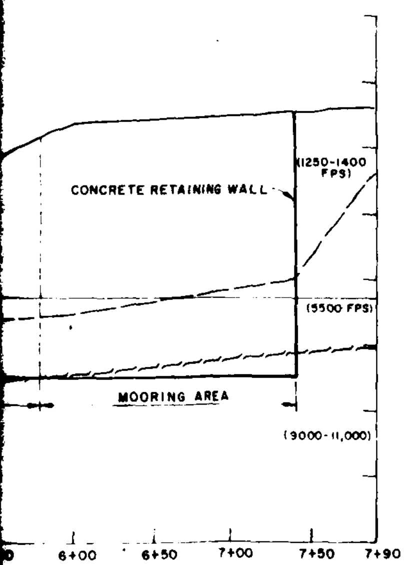


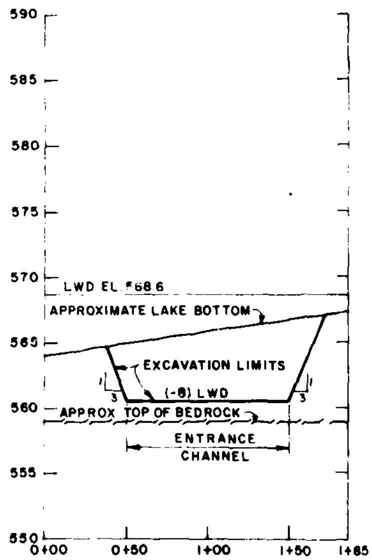

GEOLOGIC SECTION ② STA. 11+05




GEOLOGIC SECTION ③ STA. 2+85




GEOLOGIC SECTION ④ STA. 2+85

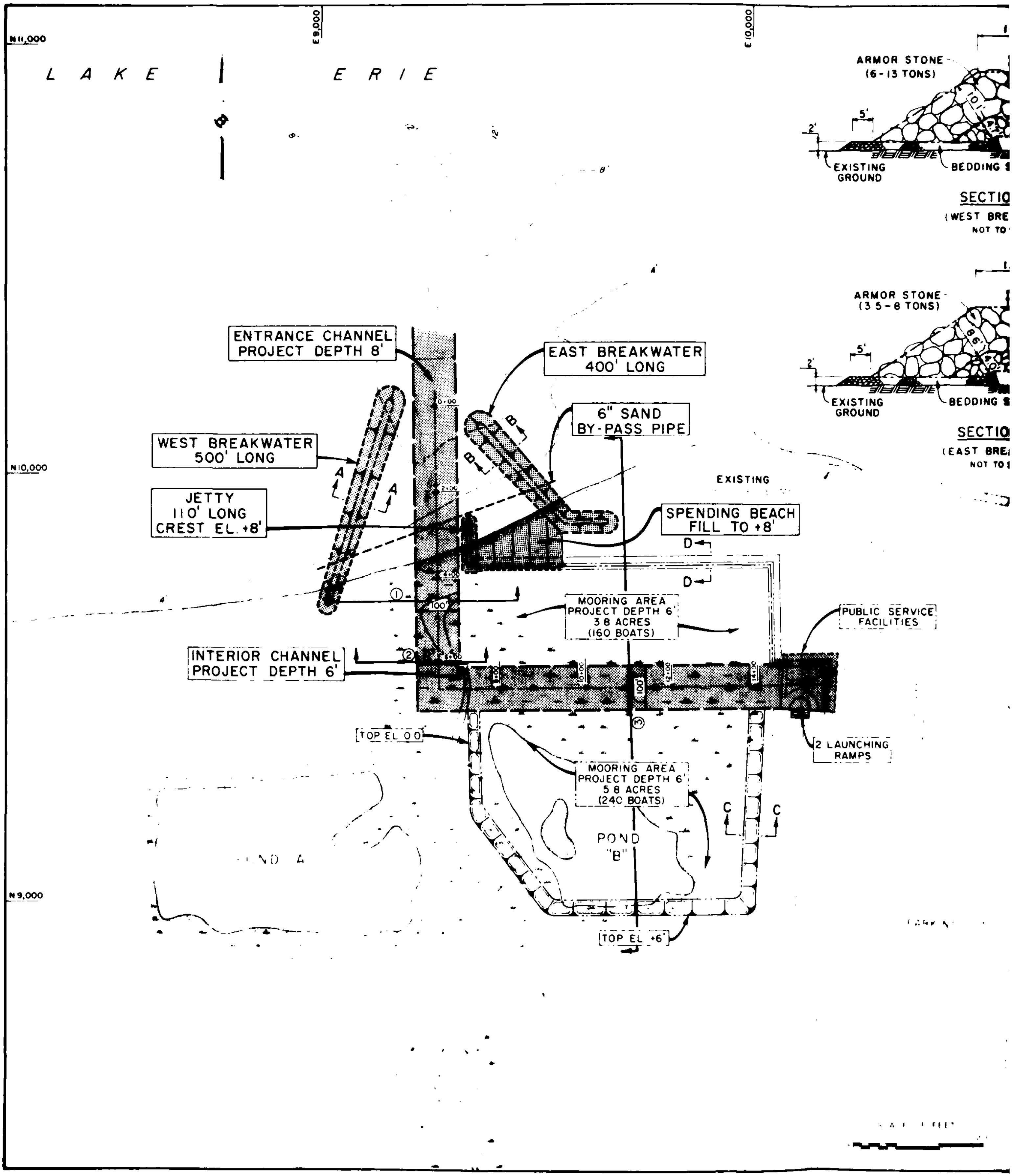
NOTES:

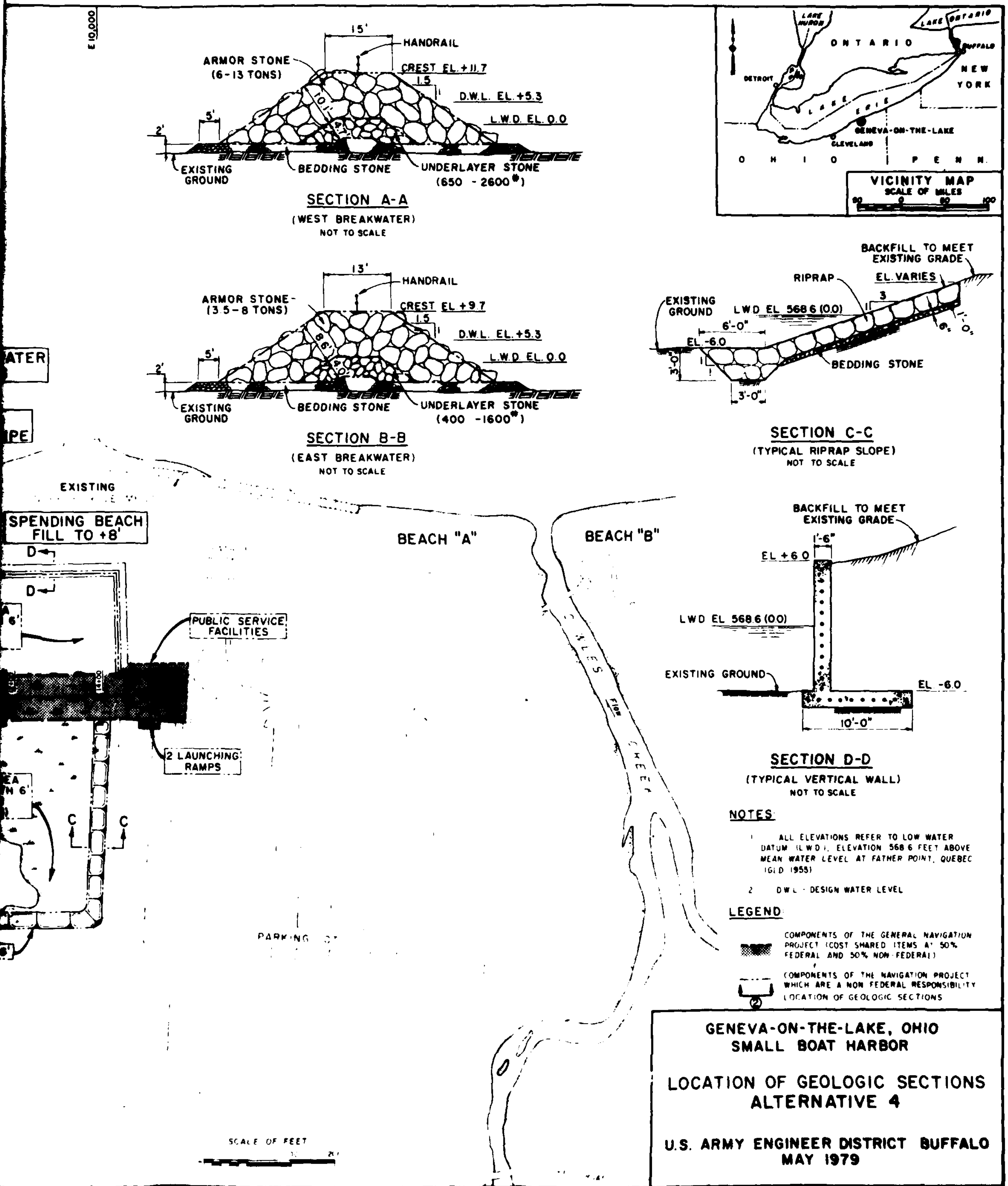
1 FOR LOCATIONS OF GEOLOGIC SECTIONS, SEE PLATE A8
2 FPS INDICATES VELOCITIES FROM SEISMIC SURVEY

GENEVA-ON-THE-LAKE, OHIO
SMALL BOAT HARBOR

**GEOLOGIC SECTIONS**
**ALTERNATIVE 3**

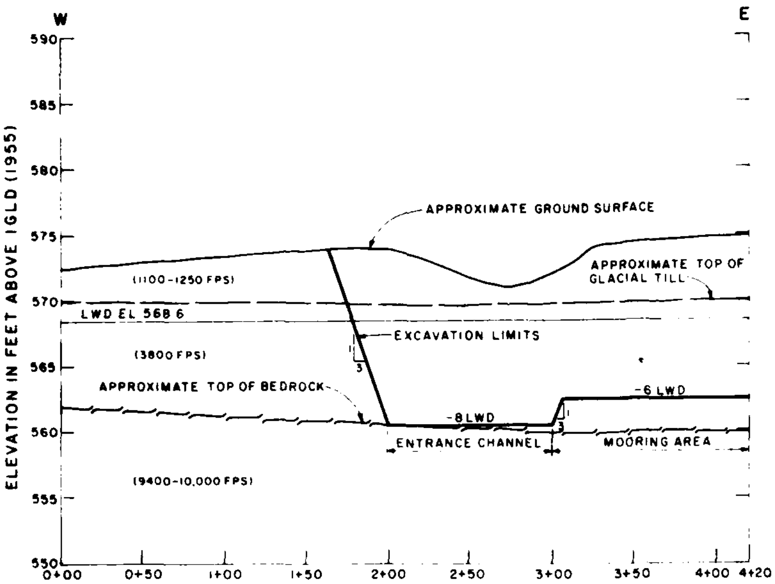
U.S. ARMY ENGINEER DISTRICT, BUFFALO
MAY 1979


N11,000
E 9,000
E 10,000
LAKE ERIE
N10,000
N 9,000
ENTRANCE CHANNEL
PROJECT DEPTH 8'
EAST BREAKWATER
400' LONG
6" SAND
BY-PASS PIPE
WEST BREAKWATER
500' LONG
JETTY
110' LONG
CREST EL. +8'
EXISTING
SPENDING BEACH
FILL TO +8'
MOORING AREA
PROJECT DEPTH 6'
3.8 ACRES
(160 BOATS)
PUBLIC SERVICE
FACILITIES
INTERIOR CHANNEL
PROJECT DEPTH 6'
TOP EL 0.0
2 LAUNCHING
RAMPS
MOORING AREA
PROJECT DEPTH 6'
5.8 ACRES
(240 BOATS)
POND
"B"
TOP EL +6'
ARMOR STONE
(6-13 TONS)
EXISTING
GROUND
ARMOR STONE
(3.5-8 TONS)
EXISTING
GROUND

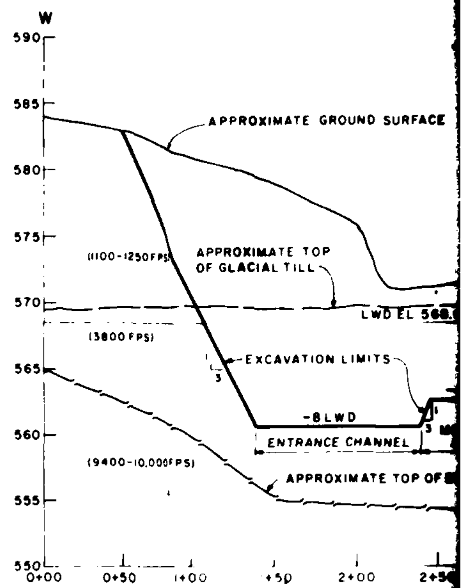


E 10,000
15'
HANDRAIL
ARMOR STONE (6-13 TONS)
CREST EL.+11.7
1.5
D.W.L. EL.+5.3
L.W.D. EL.0.0
5'
2'
EXISTING GROUND
BEDDING STONE
UNDERLAYER STONE (650 - 2600#)
SECTION A-A
(WEST BREAKWATER)
NOT TO SCALE
13'
HANDRAIL
ARMOR STONE - (3.5 - 8 TONS)
CREST EL.+9.7
1.5
D.W.L. EL.+5.3
L.W.D. EL.0.0
5'
2'
EXISTING GROUND
BEDDING STONE
UNDERLAYER STONE (400 - 1600#)
SECTION B-B
(EAST BREAKWATER)
NOT TO SCALE
LAKE HURON
LAKE ONTARIO
ONTARIO
BUFFALO
DETROIT
NEW YORK
LAKE ERIE
GENEVA-ON-THE-LAKE
CLEVELAND
OHIO
PENN.
VICINITY MAP
SCALE OF MILES
BACKFILL TO MEET EXISTING GRADE
RIPRAP
EL. VARIES
EXISTING GROUND
LWD EL 568.6 (0.0)
6'-0"
EL.-6.0
3'-0"
3'-0"
3
1'-0"
BEDDING STONE
SECTION C-C
(TYPICAL RIPRAP SLOPE)
NOT TO SCALE
ATER
PE
EXISTING
SPENDING BEACH FILL TO +8'
BEACH "A"
BEACH "B"
PUBLIC SERVICE FACILITIES
2 LAUNCHING RAMPS
FLOW
PARKING
BACKFILL TO MEET EXISTING GRADE
1'-6"
EL +6.0
LWD EL 568.6 (0.0)
EXISTING GROUND
EL -6.0
10'-0"
SECTION D-D
(TYPICAL VERTICAL WALL)
NOT TO SCALE
NOTES
1. ALL ELEVATIONS REFER TO LOW WATER DATUM (L.W.D.), ELEVATION 568.6 FEET ABOVE MEAN WATER LEVEL AT FATHER POINT, QUEBEC (IGLD 1955)
2. DWL - DESIGN WATER LEVEL
LEGEND
COMPONENTS OF THE GENERAL NAVIGATION PROJECT (COST SHARED ITEMS AT 50% FEDERAL AND 50% NON-FEDERAL)
COMPONENTS OF THE NAVIGATION PROJECT WHICH ARE A NON FEDERAL RESPONSIBILITY
LOCATION OF GEOLOGIC SECTIONS
SCALE OF FEET
GENEVA-ON-THE-LAKE, OHIO
SMALL BOAT HARBOR
LOCATION OF GEOLOGIC SECTIONS
ALTERNATIVE 4
U.S. ARMY ENGINEER DISTRICT BUFFALO
MAY 1979

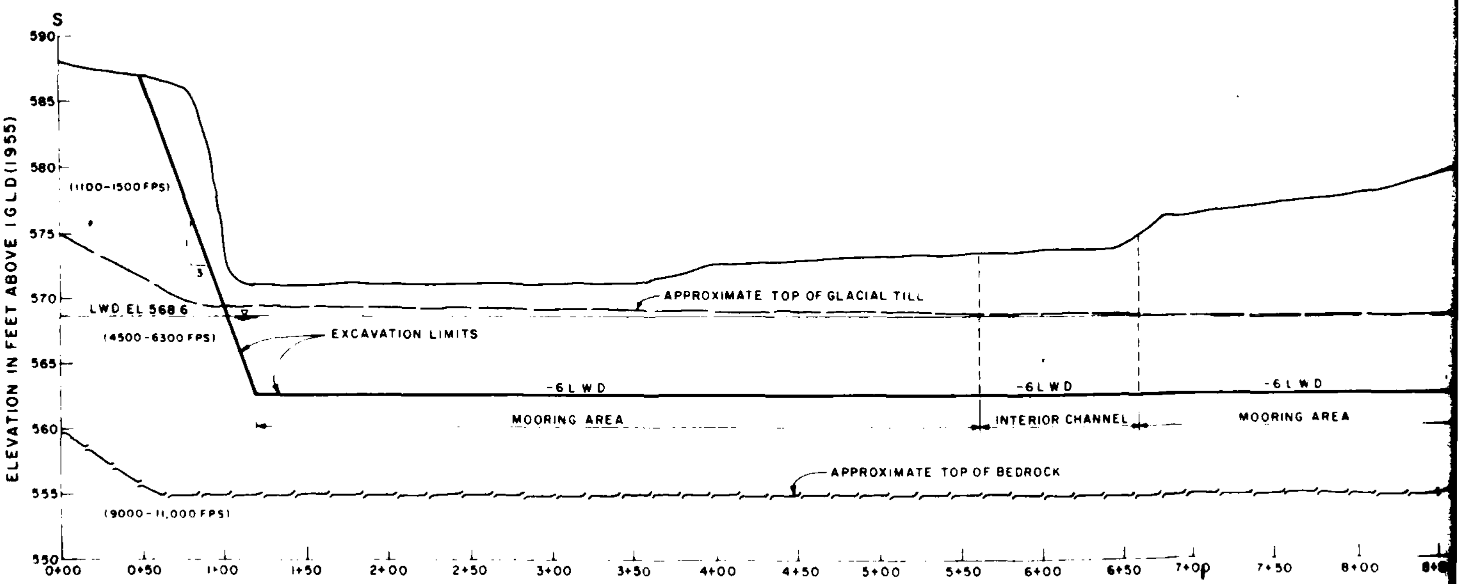

PLATE A10



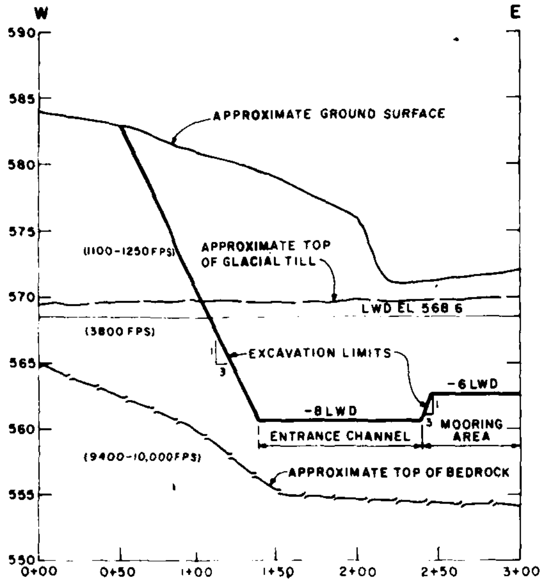

GEOLOGIC SECTION ① STA. 4+50



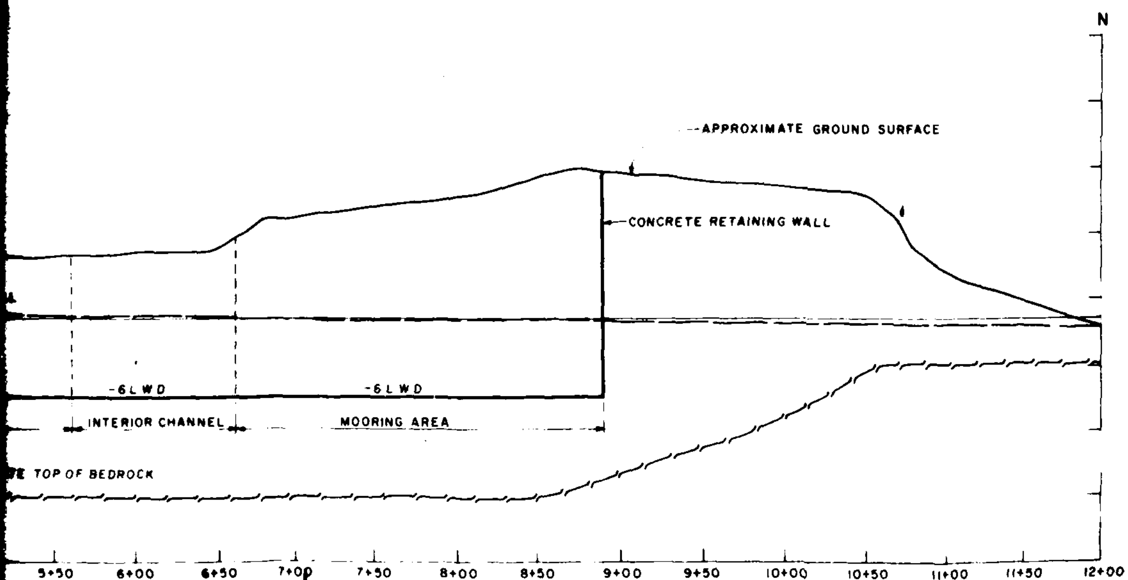

GEOLOGIC SECTION ② STA 6+00




GEOLOGIC SECTION ③ STA 11+00




GEOLOGIC SECTION ② STA. 6+00




...OGIC SECTION ③ STA. 11+00

NOTES:

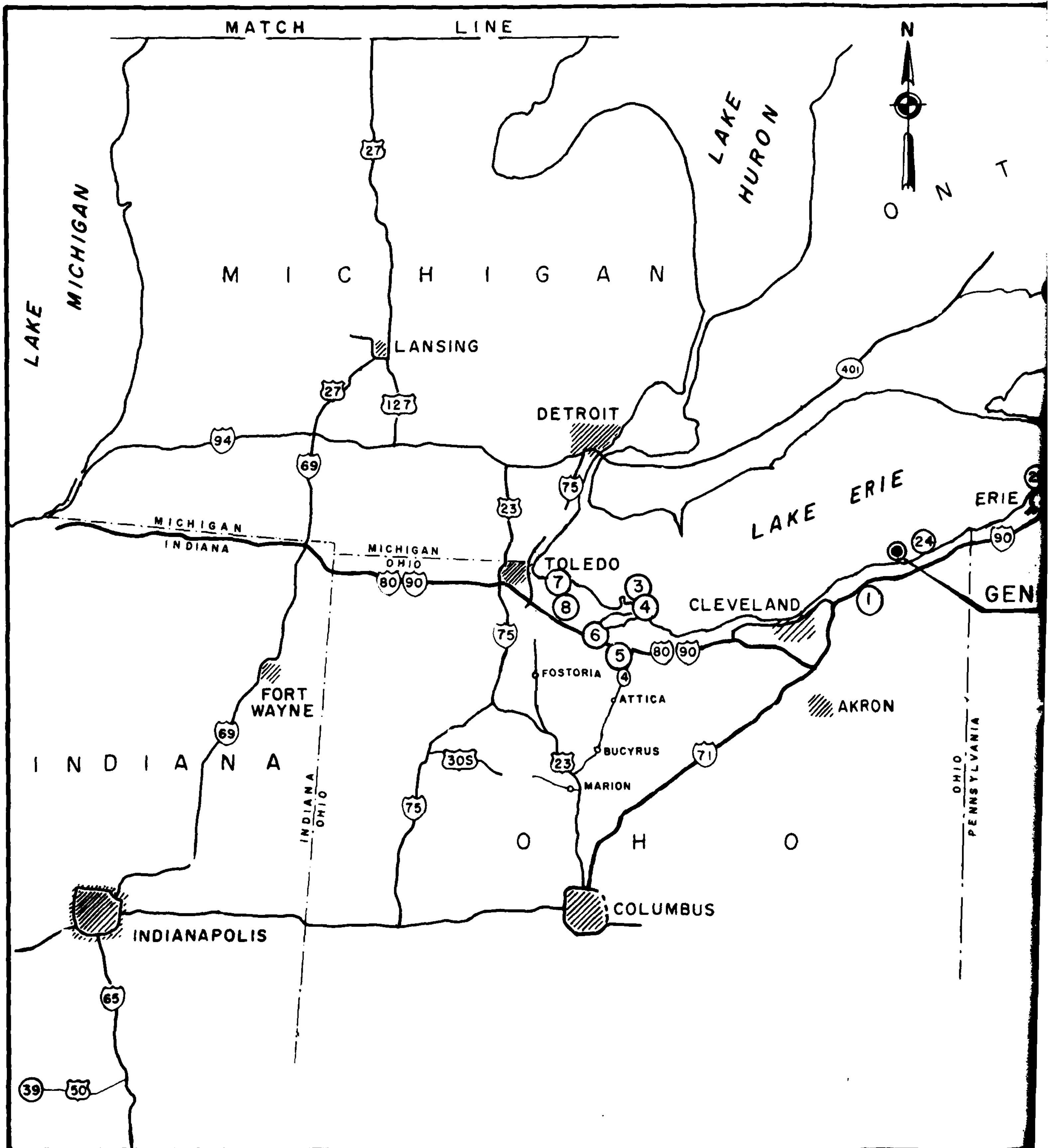
1 FOR LOCATIONS OF GEOLOGIC SECTIONS, SEE PLATE A10
2 FPS INDICATES VELOCITIES FROM SEISMIC SURVEY

GENEVA-ON-THE-LAKE, OHIO
SMALL BOAT HARBOR

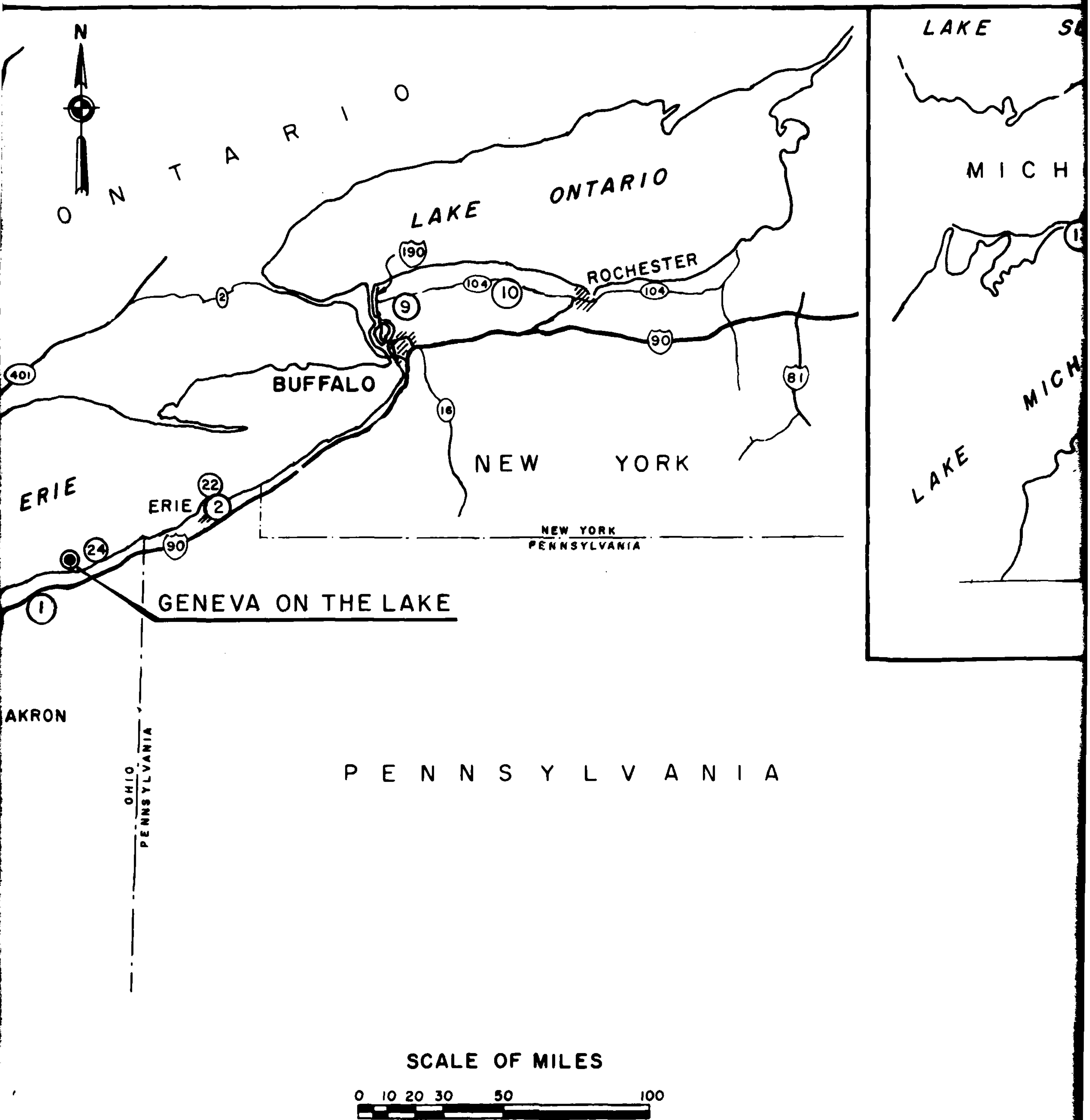
**GEOLOGIC SECTIONS**
**ALTERNATIVE 4**

U.S. ARMY ENGINEER DISTRICT BUFFALO
MAY 1979

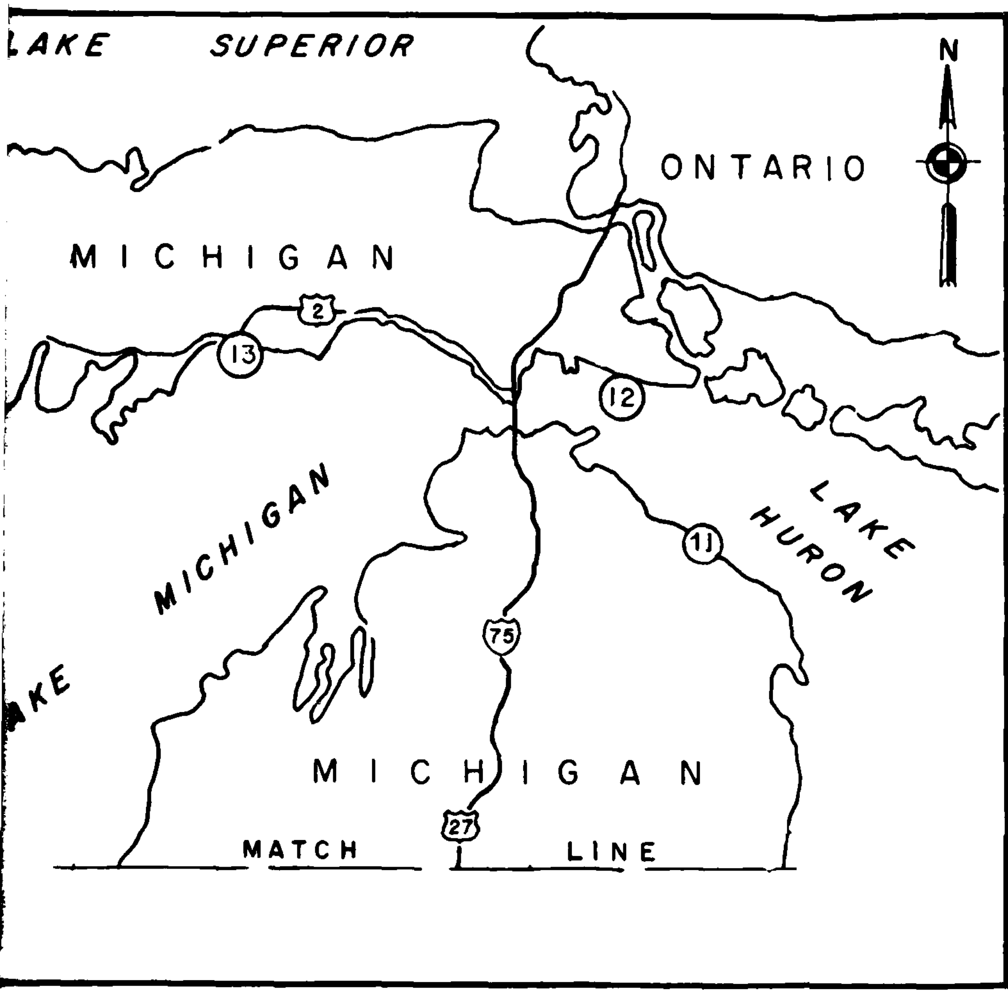
PLATE A11



MATCH LINE
LAKE MICHIGAN
LAKE HURON
MICHIGAN
ONT
LANSING
27
127
94
69
DETROIT
75
23
401
LAKE ERIE
ERIE
24
90
MICHIGAN
INDIANA
MICHIGAN
OHIO
80 90
TOLEDO
7
8
3
4
6
5
CLEVELAND
1
GEN
FOSTORIA
ATTICA
BUCYRUS
MARION
AKRON
71
FORT WAYNE
INDIANA
30S
INDIANA
OHIO
OHIO
PENNSYLVANIA
OHIO
COLUMBUS
INDIANAPOLIS
65
39
50


N
ONTARIO
LAKE ONTARIO
ROCHESTER
BUFFALO
NEW YORK
ERIE
ERIE
GENEVA ON THE LAKE
AKRON
NEW YORK
PENNSYLVANIA
OHIO
PENNSYLVANIA
PENNSYLVANIA
LAKE
MICH
LAKE MICH
190
104
10
9
2
104
90
401
81
16
22
2
24
90
1
SCALE OF MILES
0 10 20 30 50 100

2




NOTES:

1. NUMBER IN CIRCLE
SITE.

2. FOR QUARRY NAM
SEE MAP SUPPLEME

GENEVA

LO
POSSIBLE

U.S. ARMY E
TO ACCOMPANY G

13

NOTES:

1. NUMBER IN CIRCLE INDICATES QUARRY SITE.
2. FOR QUARRY NAMES AND PRODUCTS SEE MAP SUPPLEMENT SHEET.

GENEVA ON THE LAKE, OHIO

LOCATION MAP
POSSIBLE MATERIAL SOURCES

U.S. ARMY ENGINEER DISTRICT, BUFFALO

TO ACCOMPANY GDM, PHASE I, STAGE II

PLATE A12

4

MAP SUPPLEMENT SHEET
SUMMARY OF POSSIBLE SOURCES FOR
CONSTRUCTION MATERIALS

| SITE NUMBER | SOURCE | QUARRY OR PIT LOCATION | RADIAL DISTANCE | ARMOR STONE | UNDERLAYER STONE | CORE STONE | BEDDING/FILTER STONE | 12-INCH RIPRAP | COARSE AGGREGATE | FINE AGGREGATE |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | R.W. SIDLEY, INC. | THOMPSON, OH | 12 MI. | | | | | | | X |
| 2. | ERIE SAND AND GRAVEL, INC. | ERIE, PA | 60 MI. | | | | | | X | X |
| 3. | QUALITY QUARRIES | KELLEYS ISLAND, OH | 93 MI. | X | X | | | X | | |
| 4. | STANDARD SLAG CO. | MARBLEHEAD, OH. | 94 MI. | X | X | X | X | X | X | |
| 5. | SANDUSKY CRUSHED STONE CO. | PARKERTOWN, OH | 101 MI. | | | X | X | X | | |
| 6. | ERIE BLACKTOP, INC. | CASTALIA, OH | 102 MI. | | | | X | X | | |
| 7. | WHITEROCK QUARRY | CLAY CENTER, OH | 125 MI. | | X | | X | X | | |
| 8. | WOODVILLE LIME & CHEMICAL CO. | WOODVILLE, OH | 126 MI. | | X | | X | X | X | |
| 9. | FRONTIER STONE PRODUCTS | LOCKPORT, N.Y. | 150 MI. | X | X | X | X | X | X | |
| 10. | MEDINA SANDSTONE CO. | HULBERTON, N.Y. | 180 MI. | X | X | | | | | |
| 11. | U.S. STEEL CORP. | ROGERS CITY, MI. | 290 MI. | | | X | | | | |
| 12. | U.S. STEEL CORP. | CEDARVILLE, MI | 330 MI. | | | X | | | | |
| 13. | INLAND LIME AND STONE CO. | GULLIVER, MI. | 380 MI. | | | X | | | | |

12

ARMOR STONE

TYPE A 11-24 TONS
TYPE B 3.5-8 TONS
TYPE C 3.0-6 TONS
TYPE D 2.5-5.5 TONS

UNDERLAYER STONE

TYPE E 1200 - 4800 POUNDS
TYPE F 400 - 1600 POUNDS
TYPE G 300 - 1300 POUNDS
TYPE H 275 - 1100 POUNDS

CORE STONE

TYPE I 3 - 240 POUNDS
TYPE J 1 - 81 POUNDS
TYPE K 0.8 - 65 POUNDS
TYPE L 0.7 - 55 POUNDS

BEDDING/FILTER

TYPE M NO. 200 SIEVE - 5 INCHES

12 INCH RIPRAP

TYPE N 3.5 - 84 POUNDS

COARSE AGGREGATES

TYPE O NO. 8 SIEVE - 1 1/2 INCHES

FINE AGGREGATES

TYPE P NO. 200 SIEVE - 3/8 INCH

GENEVA ON THE LAKE, OHIO

# MATERIAL SURVEY SUMMARY OF SOURCES

U.S. ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY GDM, PHASE I, STAGE II

APPENDIX B

DESIGN AND COASTAL PROCESSES

GENEVA-ON-THE-LAKE SMALL-BOAT HARBOR

STAGE 2 REPORT
OF
REFORMULATION PHASE I GENERAL DESIGN MEMORANDUM

U. S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, NY 14207

GENEVA-ON-THE-LAKE, OHIO

GENERAL DESIGN MEMORANDUM
PHASE I
STAGE 2 REPORT

APPENDIX B
DESIGN AND COASTAL PROCESSES

## Table of Contents



Rev April 1980

Table of Contents (Cont'd)



Tables



Figures

## INTRODUCTION

### B1. GENERAL

This appendix presents the coastal processes, the considerations for alternative development, the design criteria, and the detailed design including stone size computation and structure cross sections for the small-boat harbor-of-refuge at Geneva State Park, OH. Four alternative plans were developed and designed. All alternative plans include at least two rubblemound breakwaters, an entrance channel, and an inner harbor enclosed mooring area. Sand bypassing is anticipated with each alternative to maintain the shoreline status quo.

B2. Alternative 2 includes an offshore mooring area protected by a rubblemound breakwater enclosure and a small breakwater sand trap. Alternative 1 includes a long west breakwater and dogleg and an interior breakwater to protect boats moored at the mouth of Cowles Creek. An arrowhead breakwater configuration is planned for Alternatives 3 and 4. The interior basin configurations with each alternative were developed considering the restrictions of bedrock, existing park facilities, environmental concerns, and the safe harbor requirements of the anticipated fleet. Plans for each alternative are shown on Plates 12-15, Appendix I.

## COASTAL PROCESSES

### B3. GENERAL

The natural processes which influence the coast of Geneva State Park must be considered in developing each design alternative. The wave climate, lake level fluctuations, current patterns, and littoral transport dictate the design requirements. These processes have continued since post-glacial periods to modify the shore and will continue after harbor construction. The engineering soundness and environmental suitability of the project depends on how well it responds to these natural processes.

### B4. LAKE LEVELS

The water levels in Lake Erie Basin have changed much in post-glacial times. This is due to crustal uplift, climatic changes, and the diversion of outlets. The present outlet, the Niagara River, is controlled by a bedrock threshold at Buffalo, NY, which is slowly rising due to isostatic rebound of the crust. After glacial retreat, the Niagara outlet was opened, but due to crustal downwarping caused by the weight of the glaciers, this outlet was more than 100 feet lower than it is today.

B5. As the glaciers advanced and wanned and as the outlets changed, the lakes which have occupied the present Erie Basin have had water levels which are both higher and also lower than the present level. Since about 3,500 years before the present modern Lake Erie has existed, the average lake level has been rising at an approximate rate of one-foot per 300 years.

B6. Modern Lake Erie water levels are also influenced by periodic fluctuations as the water content in the basin increases and decreases in response to major climatic fluctuations and seasonal variations. The lake level at a particular point along the shore also changes as strong winds or barometric changes cause the water surface to oscillate.

B7. WINDS

The predominant wind direction is responsible for the local wave climate and the direction of littoral drift in the reach from Ashtabula to Fairport Harbor, OH. The magnitude, proportion of total time, and direction of the wind is indicated on the following diagrams for the two stations (Figures B1 and B2).

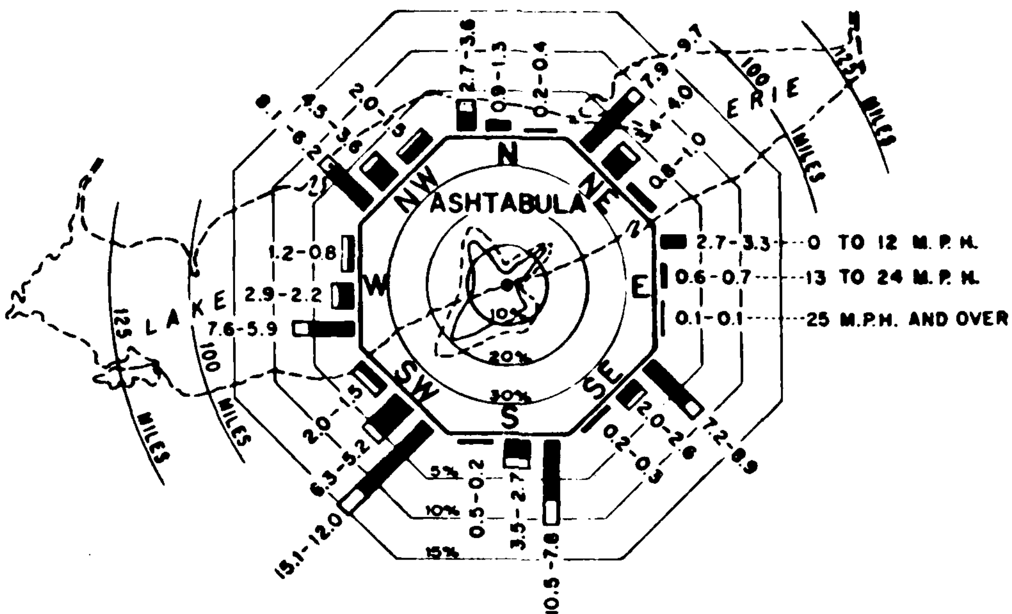
B8. WAVE CLIMATE

The wave climate experienced at Geneva State Park mirrors the wind diagrams. Winds from the southwest through east approach the shore from the land and are not significant in generating local waves. Winds which approach from the west through the north, travel across a long stretch of open water and tend to be strong and of long duration. Winds from the east are less dominate. Consequently, the local wave climate is dominated by waves from the west and north. These waves are more frequent and also have greater design height then waves from the east.

B9. Deepwater wave characteristics for Geneva State Park, OH, were determined, in lieu of recorded observations, from a report titled "Design Wave Information for Lake Erie," published by the Waterways Experiment Station, and with the procedure outlined in paragraph 7.1 of the Shore Protection Manual published by the Coastal Engineering Research Center in 1973. Design wave conditions are further discussed under the "Design Criteria" section of this appendix.

B10. COAST BETWEEN FAIRPORT AND ASHTABULA

Harbor Structures at Fairport prevent littoral material from entering or leaving to the west and those at Ashtabula prevent material from entering or leaving to the east. Thus, the sediment budget must be balanced between Fairport and Ashtabula Harbors. The straight coast




## WIND DIAGRAM FOR ASHTABULA, OHIO

### NOTES

INDICATES DURATION FOR ICE-FREE PERIOD (MAR. TO DEC. INCL.) IN PERCENT OF TOTAL DURATION.

INDICATES DURATION FOR ICE PERIOD (JAN. TO FEB. INCL.) IN PERCENT OF TOTAL DURATION.

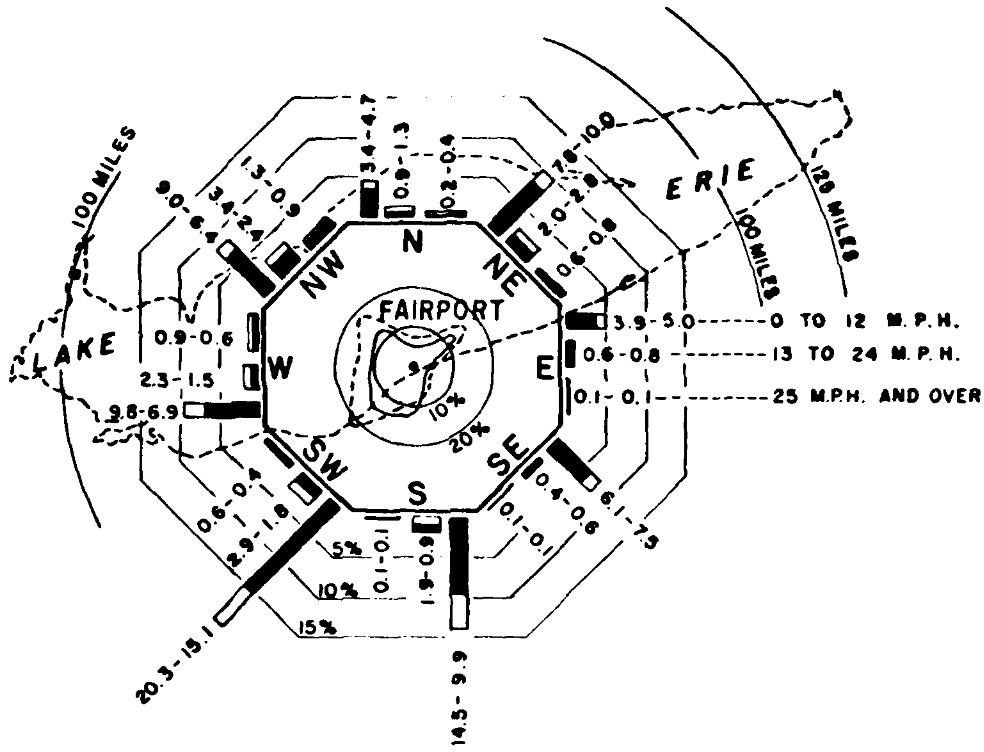
INDICATES PERCENT OF TOTAL WIND MOVEMENT OCCURRING DURING ICE-FREE PERIOD.

INDICATES PERCENT OF TOTAL WIND MOVEMENT OCCURRING DURING COMBINED ICE AND ICE-FREE PERIODS.

FIGURES AT ENDS OF BARS INDICATE PERCENT OF TOTAL WIND DURATION FOR ICE-FREE PERIOD AND COMBINED ICE-FREE AND ICE PERIODS, RESPECTIVELY.

WIND DATA BASED ON RECORDS OF THE U. S. COAST GUARD LIFE BOAT STATION AT ASHTABULA, OHIO FOR PERIOD 1 JAN. 1937 TO 31 DEC. 1968 INCL., LESS 1944, AND 1960.

FIGURE B-1




WIND DIAGRAM FOR FAIRPORT HARBOR, OHIO

NOTES

INDICATES DURATION FOR ICE-FREE PERIOD (MAR. TO DEC. INCL.) IN PERCENT OF TOTAL DURATION.

INDICATES DURATION FOR ICE PERIOD (JAN. TO FEB. INCL.) IN PERCENT OF TOTAL DURATION.

INDICATES PERCENT OF TOTAL WIND MOVEMENT OCCURRING DURING ICE-FREE PERIOD.

INDICATES PERCENT OF TOTAL WIND MOVEMENT OCCURRING DURING COMBINED ICE AND ICE-FREE PERIODS.

FIGURES AT ENDS OF BARS INDICATE PERCENT OF TOTAL WIND DURATION FOR ICE FREE PERIOD AND COMBINED ICE-FREE AND ICE PERIODS, RESPECTIVELY.

WIND DATA BASED ON RECORDS OF THE U.S. COAST GUARD AT FAIRPORT HARBOR, OHIO FOR PERIOD 1 FEB. 1932 TO 31 JAN. 1942 AND 1 JAN. 1949 TO 31 DEC. 1971.

FIGURE B-2

between Fairport and Ashtabuala Harbors can be considered as a closed system with all nearshore transport sources and sinks accountable.

B11. The shoreline is disrupted by a number of artificial structures including numerous groin variations. In addition to the structures, there are minor headlands, bluff areas, and intermittent low erosion marsh areas. The combination gives a moderately undulating appearance to the shore. The headlands, in general, appear to reflect underlying bedrock highs.

B12. The bluffs between Fairport and Ashtabula are 5 to 60 feet high and average about 40 feet high. The general surficial sequence is till unconformably upon shale and overlain by glaciolacustrine silts. Glaciolacustrine sand and gravel deposits sometimes top the silt. The thickness and presence of each layer varies from location to location.

B13. On the average, approximately 25-30 percent of the material exposed in the bluffs is potential beach-building sediment. Eroding lacustrine deposits exposed in the bluffs supply fine sand while the till supplies sand and coarser-sized material to the beaches. The streams between Fairport and Ashtabula carry little sand to the lake. Their drowned mouths act as settling basins for all but the very finest fractions.

B14. In general, the beaches are composed of medium to very coarse-grained subangular to subrounded, well-sorted lithic and quartz sand. The beaches between Fairport and Ashtabula lie upon the shale and have an average thickness of about three feet. The width of beach material between the bluffs and offshore shale bottom is generally less than 300 feet. The average grain size of the beach material decreases offshore. Due to the shale controlled offshore, the bottom slope is only four to five degrees within 50 feet of the shoreline. Thus, a small change in lake level can drastically effect the location of the shoreline.

B15. SEDIMENT SOURCES AND BLUFF RECESSION

Shore erosion between Fairport and Ashtabula is due primarily to wave erosion and mass wasting (gravity transport). In general, wave erosion is the more significant process.

B16. Shore accumulation is the result of beach material being supplied to the shore area faster than it is removed. Beach-building material could be supplied by river input, onshore movement of offshore sands, and/or bluff recession. Due to the drowned river mouths and a lack of any sand in the offshore, it is assumed that most littoral material in the Geneva State Park area is supplied by recession of the bluffs between Fairport and Ashtabula.

B17. Bluff recession is a chronic condition between Fairport and Ashtabula. Wave attack removes slumped material which promotes additonal mass wasting. If the failed soil had remained at the base of the bluff, it would serve as a toe, protecting the bluff from further failure and allowing the bluff face to eventually assume a stable slope.

B18. The nature of the mass wasting is strongly influenced by the nature of the bluff material. The clayey tills tend to fail due to debris flows. Water percolates down from the overlying ground surface and/or runs along silty seams saturating the clay. This results in saturated conditions for the soil mass and creates seepage forces which, along with the steepness of the bluff, reduces its stability. This instability results in slope failure along the bluff face.

B19. The well-sorted lacustrine silts fail most commonly as small rotational slumps or by block failure. Tension cracks form behind the surface of the bluff due to the steepness, surface unloading, and soil expansion-contraction. The bluff face deteriorates as downward percolating water loosens blocks of soil and gravity causes them to fall. The process is accelerated during high lake level when the bluff base is undercut by wave attack and support to the overlying bluff face is lost. Both types of failure can be observed in the bluffs of Geneva State Park. The various mechanisms responsible for bluff recession influence the recession rates.

B20. Bluff recession rates between Fairport and Ashtabula vary from less than one-foot per year to up to seven feet per year (just east of Fairport). On the average, the bluffs in the Geneva State Park area are 10 to 20 feet high, comprised of till overlain by lacustrine silts, and are receding at a rate less than one-foot per year. However, this recession rate is quite variable with time and location along the shoreline. During a year of high lake level, many feet of bluff may be lost and the recession rates increase to in excess of 10 feet per year, while during a year of low lake levels, the recession rate may drop to zero. A particularily high, steep bluff may recede quite rapidly while a neighboring low, vegetated bank may show no visible recession for the same period of time.

B21. The amount of bluff recession between Fairport and Ashtabula has an important impact on the amount of beach material available for littoral transport. Generally, the till exposed in the bluff contains 80 percent silt and clay, 15 percent sand, and five percent gravel. The lacustrine silts and clays contain less than five percent sands and gravels. The sporatic sandy zones, which in some areas form the entire bluff and in some other areas appear only as a thin layer on top of the silts and clays, are over 80-90 percent beach-building material. On the average, 25-30 percent of the total bluff face is potential beach-building material.

B22. LITTORAL TRANSPORT RATES

Sediment available for littoral transport can enter the nearshore system from stream input, onshore movement of offshore sands, and bluff recession. The Federal harbors at Fairport and Ashtabula bracket the littoral reach which includes Geneva State Park and has an internally complete sediment budget. In other words, what erodes from one portion of this reach must accrete somewhere else within the same reach.

B23. Between Fairport and Ashtabula most of the streams are small (Cowles Creek has a drainage of 23 square miles) and have drowned, estuarine lower reaches which act as settling basins for much of the stream's sediment load. Thus, little but the very finest fraction of fluvially transported material reaches the lake.

B24. Sampling results (Appendix A) indicate that there are no sands offshore of the beach zone which are available for onshore transport. Thus, the offshore is probably not a significant source of littoral material. All the known field evidence and researched literature suggests that almost all of the material available for littoral transport is supplied by bluff recession.

B25. In order to develop a reasonable "ballpark" estimate of littoral transport rates between Fairport and Ashtabula, it was necessary to make the following assumptions:

a. That the drift rate is controlled directly by the amount of material available for transport (typically the wave energy is capable of transporting all the available littoral material);

b. That the primary source of littoral material is bluff recession; and

c. That the major permanent littoral sink for this 26-mile long section of coast is the fillet at Ashtabula Harbor. Other losses to the drift regime are limited to temporary storage in fillets associated with groin fields and small beaches, and offshore losses where small creeks blow through littorally deposited bars diverting drift out into small offshore deltas.

B26. With these assumptions, a number of different approaches were taken to determine the littoral transport rates. The littoral accumulation rate at the Ashtabula Harbor west breakwater is 4,148,000 cubic yards between 1876 and 1974, or 42,326 cubic yards per year (Ashtabula Harbor Section 111, 1977). The annual littoral input due to bluff recession between Fairport and Ashtabula was calculated from the bluff recession rates, bluff heights, reach length, and geology presented in Carter, 1977, Sediment-Load Measurements Along the

United States Shore of Lake Erie, ODNR Report No. 102. Bluff recession contributed 16,370 cubic yards per year between Ashtabula and Geneva State Park, and 33,314 cubic yards per year between Geneva State Park and Fairport. Thus, the total bluff recession input to the littoral regime is approximately 50,000 cubic yards per year. This number is quite compatible with the observed accumulation rate at Ashtabula Harbor.

B27. An evaluation was made of the wave energy per littoral transport direction by interpolating from Saville, 1953 Wave and Lake Level Statistics for Lake Erie, BEB TM No. 37, "Statistical Energy Data Per Direction for Ice-Free Period" for Cleveland, OH, and Erie, PA. The data was compiled and weighed according to the wave approach angle with the shoreline. This evaluation suggests that 67 percent of the wave energy comes from a westerly direction (promotes easterly drift), and 33 percent comes from an easterly direction (promotes westerly drift). If the gross drift is assumed at 50,000 cubic yards per year, then the net drift to the east is approximately 33,500 cubic yards per year, and the net drift to the west is approximately 16,500 cubic yards per year.

B28. In summary, preliminary estimates suggest that approximately 30,000 to 50,000 cubic yards per year of littoral drift passes Geneva State Park. About two-thirds of this material is moving west to east. Onshore movement is insignificant. Offshore transport is minor except at Cowles Creek where littoral material is periodically diverted offshore forming an offshore delta.

B29. MINIMIZING IMPACTS ON THE COASTAL PROCESSES

Any feature which protrudes from the shoreline will impact upon the local coastal processes. The local wave climate and current pattern and the resultant sediment transport will be modified. Each of the four alternative plans will trap littoral transport on the west side and deprive the east side of sediment. The area contained within the protection of the breakwater structures will no longer contribute sediment to the nearshore by shoreline recession. Currents will travel around the structure ends promoting more offshore transport of the nearshore sediment.

B30. To minimize downdrift impacts and reduce the offshore transport sand, each alternative plan includes the provision for sediment bypassing. Material will be transported from the west to the east of the structures on a periodic basis. Frequent bypassing will reduce the offshore losses caused by an extensive lakeward buildup of the subaqueous beach face. Individual storms may cause damage to the areas immediately downdrift of the harbor structures between bypassing operations. In the case of Alternative 1, the bluff area

to the east of the proposed structures may experience accelerated erosion between bypassing operations. Alternatives 2, 3, and 4 should have limited downdrift impacts as the area to the east is already protected by a revetment.

## CONSIDERATIONS FOR ALTERNATIVE DEVELOPMENT

### B31. GENERAL

The proposed alternative plans include two locations for the entrance channel and for breakwater construction, one at Cowles Creek and three plans west of the bathhouse. Each alternative was designed in consideration of the known geologic, hydraulic, environmental, and sociological constraints.

### B32. BREAKWATER SYSTEM

The proposed breakwater system is designed to maintain an entrance channel free from littoral drift and create a safe entrance during design conditions. Thus, the entrance structures must provide a relatively impermeable barrier that prohibits littoral drift from passing through, over, or around them.

B33. Rubblemound construction with a design side slope of 1:1.5 was used for both the lake and channel sides of the structures. The rubblemound structures will prevent or reduce the transmission of wave energy into the entrance channel and interior harbor by absorbing some of this energy and by reflecting as much of the remaining energy as possible back toward the lake. The crest elevations for the breakwaters were designed allowing overtopping of the structures by the design waves which would regenerate a maximum three-foot interior wave height in the entrance channel and allow no more than a one-foot high wave in the inner harbor. The entrance structures were designed on the premise of using stone having a density of 155 pounds per cubic foot.

B34. The rubblemound structures have a protective stone armored outer layer, an underlayer of smaller sized stone, and a core to form an impermeable barrier which will reduce the potential energy that is transmitted by hydrostatic pressure differentials through the voids in the stonework, thereby reducing the waves in the entrance channel. The integrity of the rubblemound structures is largely dependent upon the stability of the stone placement. Therefore, a bedding layer of spalls or quarry waste will be placed on the bottom of the lake to prevent the large armor stone from sinking into the bottom, particularly in the nearshore, and thereby losing their usefulness. Should later studies reveal that the breakwater foundation beyond the littoral zone is exposed bedrock, the structure cross section will be modified accordingly.

B35. ENTRANCE CHANNEL

The breakwater entrance must be oriented so that the entrance channel allows a reasonable line of approach for boats during storm conditions. The entrance channel must be wide enough and deep enough to allow two-way traffic of the total recreational fleet. Experience with similar small boat harbor projects in the Buffalo District has indicated that a 100-foot wide, eight-foot deep entrance is sufficient to meet this requirement. Workshops with the boating public and review of this criteria during the Stage 3 studies is planned. The entrance channel should be relatively straight. One or two oblique turns may be necessary, but they should be kept to a minimum.

B36. INNER HARBOR

The inner harbor mooring area must be of sufficient size to provide docking for 400 boats and include the necessary support facilities. Wave heights in the inner harbor must not exceed one-foot. Therefore, the enclosed mooring basin must be of a geometry and contain wave absorbing surfaces sufficient to limit internal wave oscillation and amplification. The proposed harbor geometry is, of necessity due to bedrock limitations, generally rectangular with right angles. In order to reduce the subsequent tendency for wave reflection off of opposite walls, sloped side walls were proposed where ever feasible. Sloped, riprap walls will absorb the trapped wall energy. Should the hydraulic model study planned for Stage 3 indicate that additional wave absorption is necessary, the model will be tested with variations on the basin geometry, additional sloped walls, and wave absorbing vertical wall units (i.e., IGLOO's, cinder blocks).

B37. SUMMARY

The final design consideration is the economic, environmental, and sociological suitability of the design. The design must minimize adverse environmental impacts to the shoreline, the interior drainage system, and to the offshore. Not only must the design have a satisfactory benefit-cost ratio, but it should be as cost effective as practical considering the other restrictions. Finally, the proposed harbor plan must merge with the existing park facilities and user patterns to provide an appealing recreational center.

B38. Each of the previously mentioned restrictions were considered in developing the four alternative plans. The recommended plan will be tested in a hydraulic model study at the Corps of Engineers Waterways Experiment Station during Stage 3 of the Phase I GDM and the early stages of the Phase II GDM. During this model study, the orientation and design of the breakwater structures, the entrance

AD-A102 194 CORPS OF ENGINEERS BUFFALO NY BUFFALO DISTRICT F/G 13/2
GENEVA-ON-THE-LAKE OHIO. SMALL BOAT HARBOR. STAGE 2 DOCUMENT FO--ETC(U)
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channel plan, and the inner harbor configuration will each be evaluated and manipulated as necessary to refine the design of the recommended plan. Additional subsurface data and the completion of the U. S. Fish and Wildlife studies will also impact upon the Stage 3 design.

## DESIGN CRITERIA

### B39. GENERAL

The entrance structures to the small-boat harbor at Geneva-on-the-Lake, OH, were analyzed using the 20-year recurrence significant deep water wave heights at Geneva, OH (Grid Point 14) as determined by Waterways Experiment Station and published in Technical Report H-76-1 "Design Wave Information for the Great Lakes - Report 1 - Lake Erie." Table B-1 of this appendix presents the significant deepwater wave heights for various recurrence intervals at Geneva and Table B-2 presents the wave periods associated with these wave heights. Angle class 1 in Tables B-1 and B-2 corresponds to waves from the east-north-east (ENE) through north (N), angle class 2 to waves from the north (N) through west-northwest (WNW), and angle class 3 corresponds to waves from the west-northwest (WNW) through west-southwest (WSW).

B40. In general, the western structure for each alternative was designed assuming direct wave attack from angle classes 2 and 3. The eastern structure was designed assuming a wave attack from either angle class 2 or angle class 1 and 2, depending on the alternative.

B41. The designed structures are of standard rubblemound design. The natural stone unit sizes are designed using a year-round, 20-year recurrence deepwater wave. The boating season at Geneva-on-the-Lake is assumed to extend from April to November, therefore, the crest height for the structures is designed using a three-season (spring, fall, and summer) 20-year recurrence deepwater wave.

B42. A refraction analysis performed by the Buffalo District for the "Geneva State Park, OH; Shore Erosion Demonstration Project Pre-Construction Report" (February 1978) was modified to provide the appropriate refraction and shoaling coefficients.

### B43. DESIGN LAKE LEVEL (DLL)

The design lake level at Geneva, OH, is defined as a 10-year recurrence event and is determined by adding the 10-year maximum monthly mean level of Lake Erie to the one-year frequency occurrence maximum short-term fluctuation. The maximum monthly mean and short-term fluctuation is determined from the lake level frequency charts developed by the Buffalo District for the (1973) "Lake Erie-Lake

TABLE B-1

TABLE OF EXTREMES ESTIMATES
GRID LOCATION 8,14 LAT=41.52 LON=80.98 GENEVA OH
SHORELINE GRID POINT 14

WINTER

ANGLE CLASSES

| | 1 | 2 | 3 | ALL |
|---|---|---|---|---|
| 5 | 6.6( 0.7) | 10.5( 0.5) | 10.8( 0.4) | 12.3( 0.7) |
| 10 | 8.2( 0.9) | 12.1( 0.7) | 12.1( 0.5) | 13.5( 0.9) |
| 20 | 9.8( 1.1) | 13.4( 0.9) | 13.1( 0.6) | 14.8( 1.1) |
| 50 | 12.1( 1.4) | 15.4( 1.1) | 14.4( 0.8) | 16.5( 1.4) |
| 100 | 13.8( 1.6) | 16.7( 1.2) | 15.4( 0.9) | 17.8( 1.6) |

SPRING

ANGLE CLASSES

| | 1 | 2 | 3 | ALL |
|---|---|---|---|---|
| 5 | 3.6( 0.4) | 4.3( 0.7) | 6.9( 0.4) | 7.5( 0.8) |
| 10 | 3.6( 0.5) | 5.9( 1.0) | 7.9( 0.6) | 8.8( 1.0) |
| 20 | 4.6( 0.7) | 7.5( 1.2) | 9.2( 0.7) | 10.1( 1.2) |
| 50 | 5.9( 0.8) | 10.2( 1.5) | 10.5( 0.9) | 11.9( 1.5) |
| 100 | 6.9( 0.9) | 11.8( 1.7) | 11.8( 1.0) | 13.3( 1.8) |

SUMMER

ANGLE CLASSES

| | 1 | 2 | 3 | ALL |
|---|---|---|---|---|
| 5 | 4.3( 1.9) | 4.9( 0.5) | 6.2( 0.8) | 7.2( 2.0) |
| 10 | 5.2( 2.5) | 5.9( 0.7) | 7.2( 1.0) | 8.0( 2.7) |
| 20 | 6.6( 3.2) | 6.6( 0.8) | 8.2( 1.3) | 8.9( 3.3) |
| 50 | 9.2( 3.9) | 7.2( 1.0) | 9.2( 1.6) | 10.3( 4.1) |
| 100 | 11.2( 4.5) | 7.5( 1.2) | 9.8( 1.8) | 11.7( 4.8) |

FALL

ANGLE CLASSES

| | 1 | 2 | 3 | ALL |
|---|---|---|---|---|
| 5 | 8.2( 0.3) | 10.5( 0.4) | 10.8( 0.3) | 11.4( 0.4) |
| 10 | 9.2( 0.4) | 11.5( 0.5) | 11.5( 0.4) | 12.2( 0.5) |
| 20 | 9.8( 0.5) | 12.1( 0.6) | 12.1( 0.5) | 13.1( 0.7) |
| 50 | 10.5( 0.6) | 13.4( 0.8) | 13.1( 0.6) | 14.2( 0.8) |
| 100 | 11.5( 0.7) | 14.4( 0.9) | 13.8( 0.7) | 15.1( 0.9) |

TABLE B-2

GRID LOCATION 8,14 LAT=41.52 LON=80.98 GENEVA OH

GRID POINT NUMBER 14

SIGNIFICANT PERIOD BY ANGLE CLASS AND WAVE HEIGHT

| WAVE HEIGHT (FT) | ANGLE CLASS | | |
|---|---|---|---|
| | 1 | 2 | 3 |
| 1 | 2.3 | 2.3 | 2.5 |
| 2 | 3.6 | 3.6 | 3.8 |
| 3 | 4.5 | 4.5 | 4.8 |
| 4 | 5.2 | 5.2 | 5.5 |
| 5 | 5.8 | 5.8 | 6.1 |
| 6 | 6.1 | 6.1 | 6.5 |
| 7 | 6.3 | 6.4 | 6.9 |
| 8 | 6.6 | 6.6 | 7.3 |
| 9 | 6.9 | 6.9 | 7.7 |
| 10 | 7.2 | 7.2 | 8.2 |
| 11 | 7.4 | 7.5 | 8.6 |
| 12 | 7.7 | 7.8 | 9.0 |
| 13 | 8.0 | 8.0 | 9.4 |
| 14 | 8.2 | 8.3 | 9.8 |
| 15 | 8.5 | 8.6 | 10.2 |
| 16 | 8.8 | 8.9 | 10.6 |
| 17 | 9.0 | 9.2 | 11.0 |
| 18 | 9.3 | 9.4 | 11.4 |
| 19 | 9.6 | 9.7 | 11.8 |
| 20 | 9.9 | 10.0 | 12.3 |
| 21 | 10.1 | 10.3 | 12.7 |
| 22 | 10.4 | 10.6 | 13.1 |
| 23 | 10.7 | 10.8 | 13.5 |
| 24 | 10.9 | 11.1 | 13.9 |
| 25 | 11.2 | 11.4 | 14.3 |

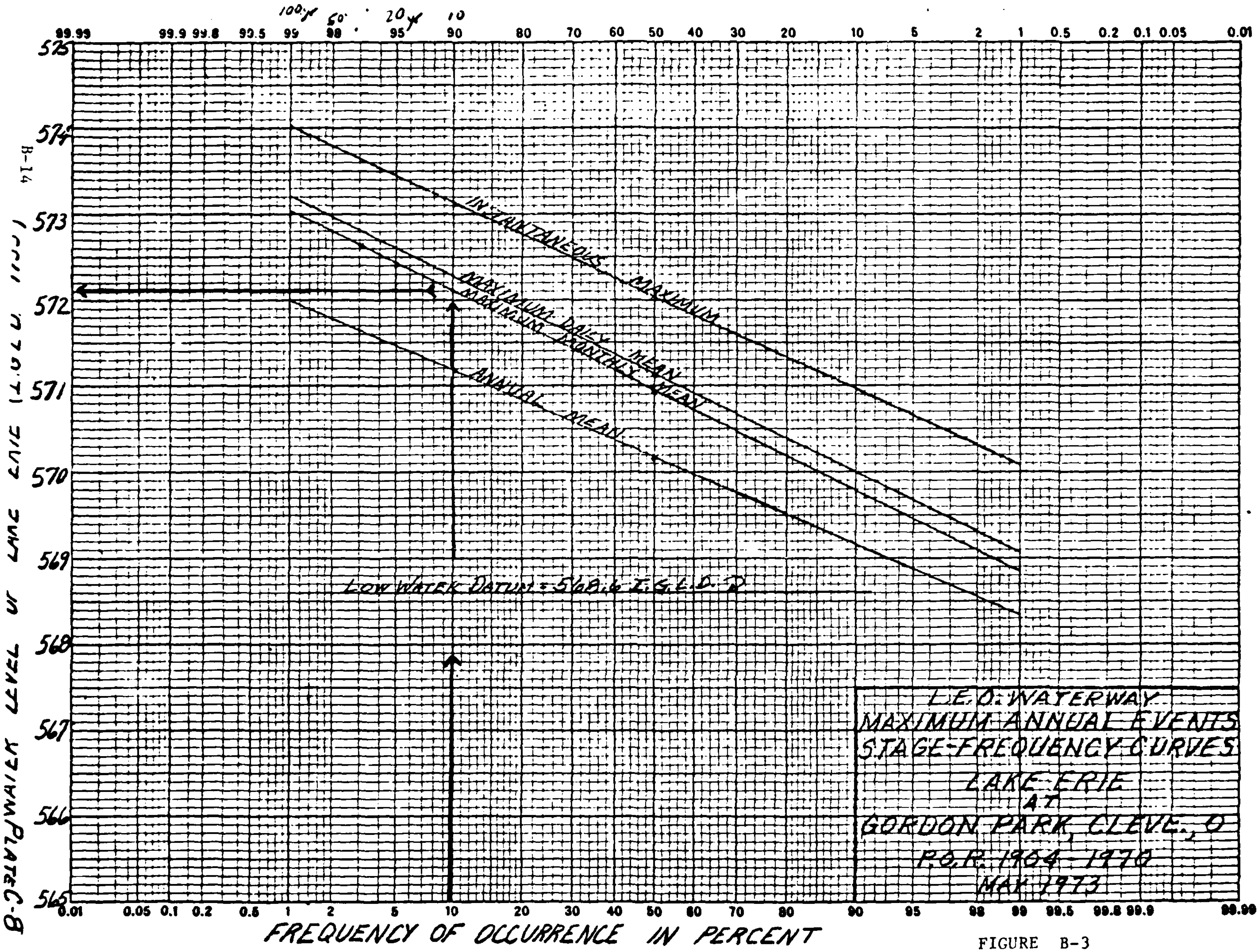
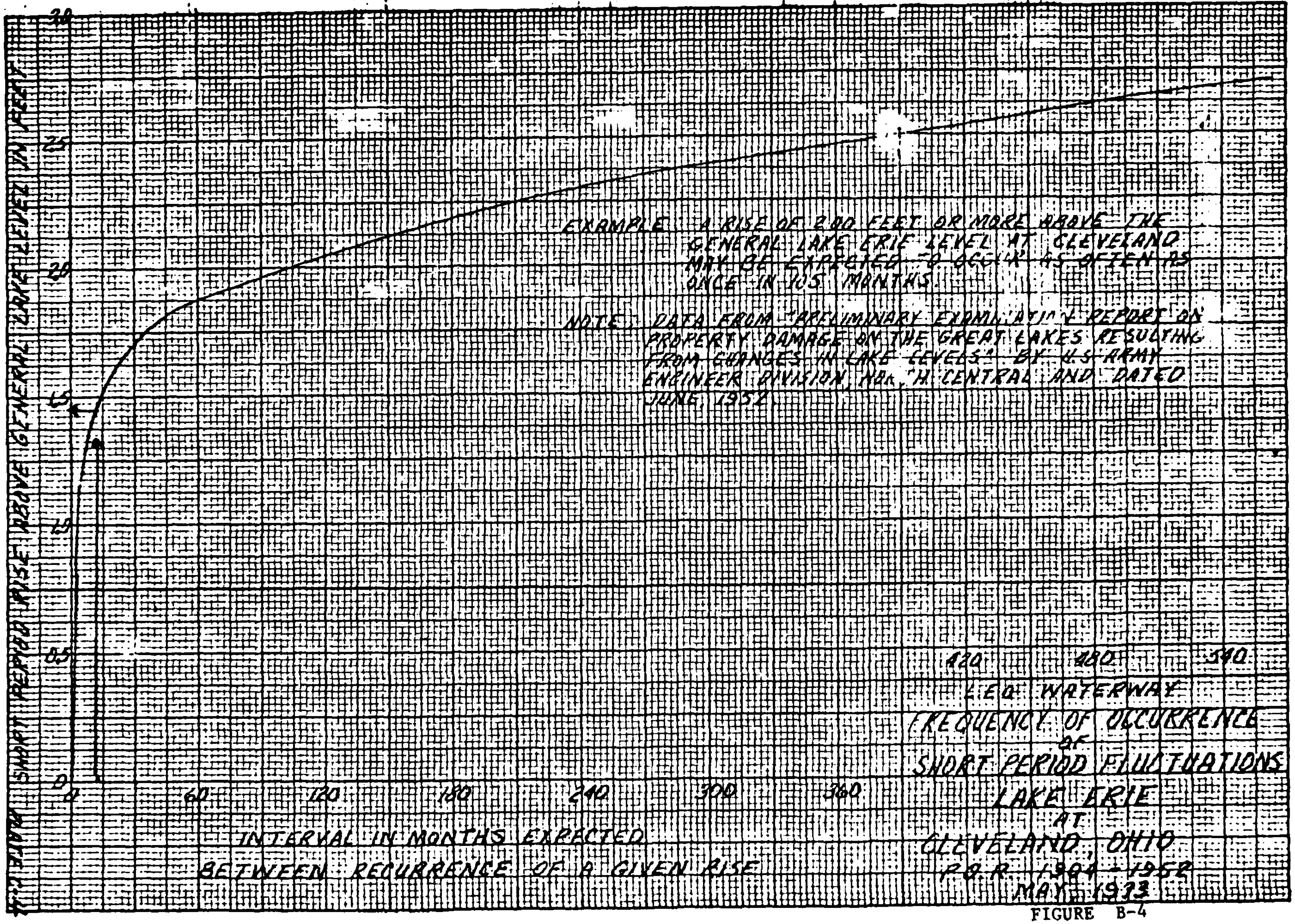



FIGURE B-3

PLATE C-8



SHORT PERIOD RISE ABOVE GENERAL LAKE LEVEL IN FEET
PLATE C-4
3.0
2.5
2.0
1.5
1.0
0.5
0
0
60
120
180
240
300
360
420
480
540
INTERVAL IN MONTHS EXPECTED
BETWEEN RECURRENCE OF A GIVEN RISE
EXAMPLE: A RISE OF 2.00 FEET OR MORE ABOVE THE GENERAL LAKE ERIE LEVEL AT CLEVELAND MAY BE EXPECTED TO OCCUR AS OFTEN AS ONCE IN 105 MONTHS.
NOTE: DATA FROM "PRELIMINARY EXAMINATION REPORT ON PROPERTY DAMAGE ON THE GREAT LAKES RESULTING FROM CHANGES IN LAKE LEVELS" BY U.S. ARMY ENGINEER DIVISION, NORTH CENTRAL AND DATED JUNE 1952.
WATERWAY
FREQUENCY OF OCCURRENCE
OF
SHORT PERIOD FLUCTUATIONS
LAKE ERIE
AT
CLEVELAND, OHIO
P.O.R. 1904-1952
MAY, 1973


FIGURE B-4

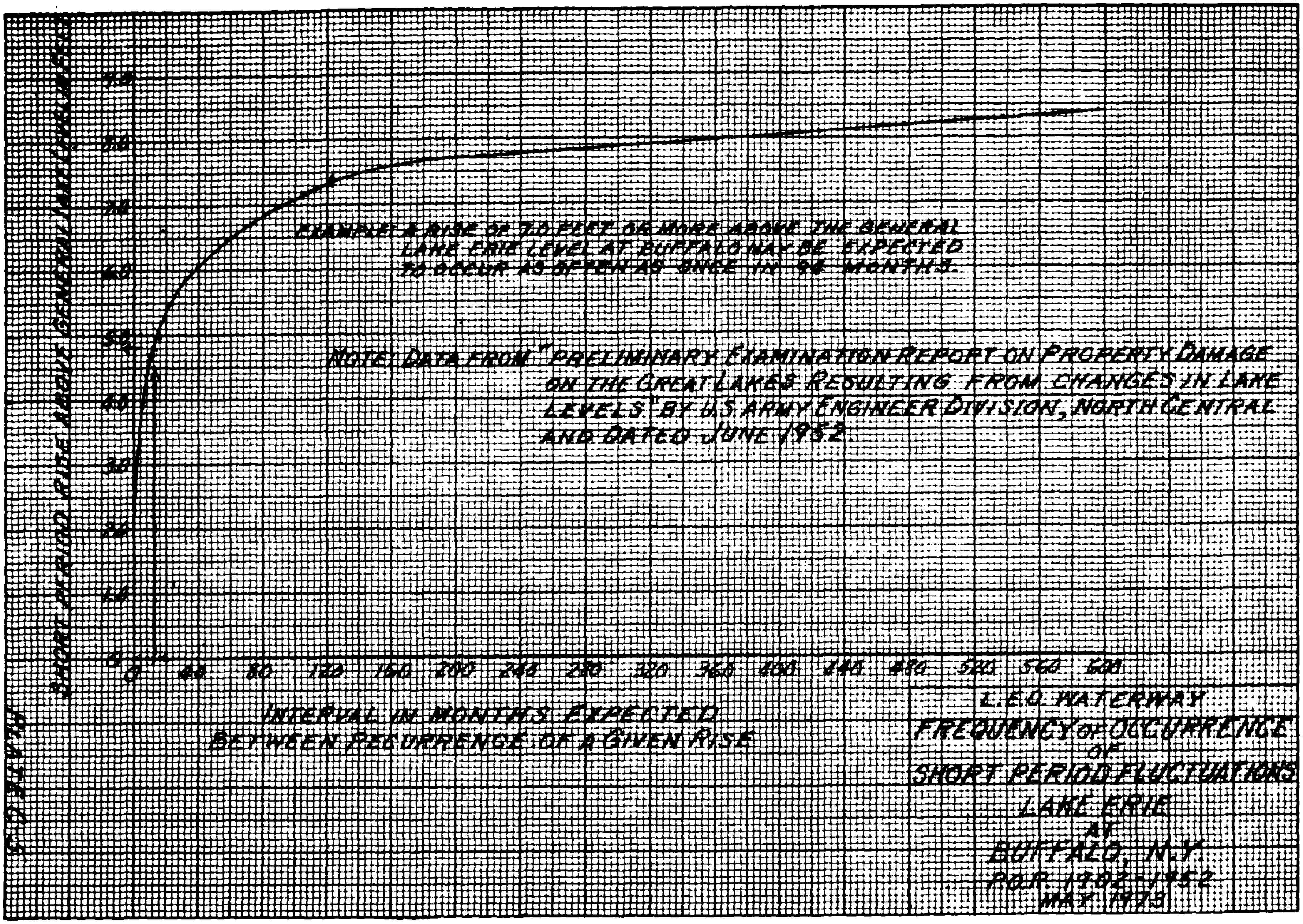

SHORT PERIOD RISE ABOVE GENERAL
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
0 40 80 120 160 200 240 280 320 360 400 440 480 520 560 600
INTERVAL IN MONTHS EXPECTED
BETWEEN RECURRENCE OF A GIVEN RISE
EXAMPLE: A RISE OF 7.0 FEET OR MORE ABOVE THE GENERAL
LAKE ERIE LEVEL AT BUFFALO MAY BE EXPECTED
TO OCCUR AS OFTEN AS ONCE IN 96 MONTHS.
NOTE: DATA FROM "PRELIMINARY EXAMINATION REPORT ON PROPERTY DAMAGE
ON THE GREAT LAKES RESULTING FROM CHANGES IN LAKE
LEVELS" BY U.S. ARMY ENGINEER DIVISION, NORTH CENTRAL
AND DATED JUNE 1952
L.E.O. WATERWAY
FREQUENCY OF OCCURRENCE
OF
SHORT PERIOD FLUCTUATIONS
LAKE ERIE
AT
BUFFALO, N.Y.
P.O.R. 1902-1952
MAY 1973
PLATE C-5

FIGURE B-5

Ontario Waterway Report, Appendix C" included as Figures B-3, B-4, and B-5. The maximum monthly mean lake level is determined from Figure B-3 (Gordon Park, Cleveland, OH), to be 572.1 feet or +3.5 feet above low water datum (LWD). A reasonable estimate of the short-term fluctuation was made by interpolating between Figure B-4 (Cleveland) and Figure B-5 (Buffalo) for Geneva. The short-term fluctuation of +1.8 feet is added to the maximum monthly mean to yield a design lake level (DLL) of 573.9 feet or +5.3 feet above LWD.

B44. DESIGN DEEP WATER WAVE (Ho)

The stone size for the entrance structures is designed to withstand the maximum 20-year recurrence wave. The following significant deep-water design waves obtained from Tables B-1 and B-2 are used in the wave analysis for stone size.

| Direction | Significant Wave Height Ho | Period To |
|---|---|---|
| ENE-N (Angle 1) | 9.8 Feet | 7.2 Sec |
| N-WNW (Angle 2) | 13.4 | 8.1 |
| WNW-WSW (Angle 3) | 13.1 | 9.4 |

B45. The crest heights for the entrance structures is designed to allow overtopping which would regenerate a maximum interior wave (transmitted wave) of 3.0 feet in the entrance channel. The onshore-offshore alternative crest height is designed to allow no more than a 1.0-foot high transmitted wave in the mooring area. Since the interior wave height is only of concern during the boating season, the maximum waves which have a 20-year recurrence during the spring, summer, or fall as obtained from Tables B-1 and B-2 are used in the wave analysis for crest height.

| Direction | Significant Wave Height Ho | Period To |
|---|---|---|
| ENE-N (Angle 1) (60°-0°) | 9.8 Feet | 7.2 Sec |
| N-WNW (Angle 2) (0°-300°) | 12.1 | 7.8 |
| WNW-WSW (Angle 3) (300°-240) | 12.1 | 9.0 |

B46. REFRACTION AND SHOALING ANALYSIS

A computer program originated by R. S. Dobson of the Waterways Experiment Station was utilized to describe the shoreward propogation of the design deepwater waves at Geneva. The refraction analysis developed by the Buffalo District for the Geneva State Park Shore Erosion Demonstration Project was rerun at only a deepwater level for the small-boat harbor project without a nearshore detailed "window." Input control parameters such as period, design lake level, ray designation, and wave heights were modified to suit this small-boat harbor design.

B47. DESIGN INCIDENT WAVE (Hi)

The design incident wave is determined from the design deepwater wave (Ho), the appropriate shoaling coefficient (Ks), and the appropriate refraction coefficient (Kr).

$$Hi = (Ho)(Ks)(Kr)$$

The Hi is the design wave used to determine stone size or crest height for each alternative at each cross section.

B48. DESIGN STRUCTURE DEPTH (ds)

Each alternative is individually evaluated to determine the design structure depth of the structure toe at critical cross section locations. The sounding at the structure toe plus the design lake level (DLL) equals the design depth of water at the structure toe (ds).

$$ds = \text{sounding} + DLL$$
$$DLL = 5.3'$$

The ds is used to determine the appropriate shoaling and refraction coefficients from the refraction analysis for each alternative cross section.

B49. BREAKING VS. NONBREAKING WAVES

Should the computed Hi indicate that the wave may break in depths greater than that in which the structure is located, the method outlined in Section 7.122 (SPM) will be used to determine the design breaker height.

$\frac{ds}{gT^2}$ will be computed and applied to SPM Figure 7-4 to determine the Hb.

B50. STONE SIZE COMPUTATION

Armor unit design was calculated by application of Hudson's formula, Shore Protection Manual, Section 7.373.

$$W = \frac{Wr\ H^3}{K_D\ (Sr-1)^3\ \text{Cot}\ \theta}$$

Where:

W = Weight of armor unit in primary cover layer (lbs.)
Wr = Stone density in $lbs/ft^3$, assume Wr = 155 pcf
H = Incident design wave height at the structure (ft.)
$K_D$ = Stability coefficient of the armor layer
$K_D$ = 3.2 for nonbreaking wave at structure head
$K_D$ = 2.9 for breaking wave at structure head
$K_D$ = 4.0 for nonbreaking wave at structure trunk
$K_D$ = 3.5 for breaking wave at structure trunk
Sr = Specific gravity of armor stone = 155/62.4 = 2.48
Cot θ = Structure side slope = 1.5

B51. Layer thickness is computed by

$$r = n_1\ K_\Delta\ \left(\frac{W}{Wr}\right)^{1/3}$$

Where:

r = Average layer thickness in feet
$n_1$ = Number of stones comprising cover layer = 2
$K_\Delta$ = Layer coefficient = 1.15 for two layers of rough quarry stone
W = Weight of an individual armor stone in cover layer
Wr = Stone density = 155 pcf

B52. Crest width is computed by

$$B = n_2\ K_\Delta\ \left(\frac{W}{Wr}\right)^{1/3}$$

Where:

B = Crest width, ft.
$n_2$ = Number of stones in crest width = 3
$K_\Delta$ = Layer coefficient = 1.15 for 2 layers of rough quarry stone
W = Weight of an individual armor stone in cover layer
Wr = Stone density = 155 pcf

B53. As the computed W is a design weight for individual armor units of a primary layer and the construction is a two-layer structure with a natural deviation to the specified W, it is reasonable to compute a range of stone sizes. The underlayer and bedding layer stone size is also computed as a range which is a function of the W.

B54. Armor Stone:

$$W\ max = 2.0\ W$$
$$W\ min = 0.9\ W$$

B55. Underlayer Stone:

$$W\ max = 0.2\ W$$
$$W\ min = 0.05\ W$$
$$r = n_1 K_\Delta \left(\frac{0.1\ W}{Wr}\right)^{1/3}$$

B56. Bedding Stone:

$$W\ max = 0.01\ W$$
$$W\ min = 0.000125\ W$$

B57. CREST HEIGHT COMPUTATION

The wave runup on the entrance structures was determined by using the method in Section 7.21 of the Shore Protection Manual (SPM) and reduced using GODA's charts, as directed by NCDED-C guidance dated 22 August 1978, to calculate the wave heights at the toe depth for the 1:10 or flatter lake bed slope at Geneva, OH. The wave runup was used in computing the required crest elevation which, when overtopped, would yield a maximum three-foot transmitted wave in the entrance channel and a maximum one-foot wave in the mooring area. The Cross and Sollitt method was used in computing the required crest heights.

$$Hbi = R\ (1.04 - Ht/0.54\ Hi)$$

Where:

Hbi = breakwater height
R = wave runup
Ht = height of transmitted wave
Hi = height of incident wave

and

Crest Elevation = DLL + Hbi = +5.3 + Hbi

## DETAILED DESIGN

### B58. GENERAL

A detailed design was prepared for each alternative plan to compute the crest height, stone size, and layer thickness for each proposed breakwater structure. The four designs with structure cross sections follow. A table summarizing the design data appears as Table B-3. Advanced design will be prepared only for the recommended alternative in Stage 3.

| COMPUTATION SHEET | DATE Feb 79 | PAGE 1A OF | FILE NUMBER |
|---|---|---|---|
| NAME OF OFFICE NCBED-DC | COMPUTATION Design Wave | | |
| SUBJECT Geneva, OH Small Boat Harbor | SOURCE DATA Plan-1 | | |
| COMPUTED BY J Pope | CHECKED BY @ 3/79 | APPROVED BY | |

659 PLAN 1 - Design wave for stone size

EAST BREAKWATER

HEAD SECTION sounding = 6.5'

$ds = 5.3 + 6.5 = 11.8$

$Ho = 9.8'$

use RAY 2 of Refraction Analysis where Period = 7.2 sec and Azimuth is 30° (Angle Class 1) and depth = 11.72 (see PLOT A)

$K_R = 1.0125$

$K_S = 1.0422$

$Hi = Ho\, K_R\, K_S = 10.34'$

$\frac{ds}{gT^2} = \frac{11.8}{(32.2)(7.2)^2} = .0071$ $m = 0.01$

$\frac{Hb}{ds} = 0.84$ (From Fig 7-4, SPM) $Hb = 0.84(11.8) = 9.9$

∴ Design wave is 9.9' breaking wave

TRUNK SECTION sounding = 4

$ds = 5.3 + 4 = 9.3$

$\frac{ds}{gT^2} = \frac{9.3}{(32.2)(7.2)^2} = .0056$ $m = 0.01$

$\frac{Hb}{ds} = 0.85$ (From Fig 7-4, SPM) $Hb = (0.85)(9.3) = 7.9$

∴ Design wave is 7.9' breaking wave

WEST BREAKWATER

HEAD SECTION sounding = 8.8'

$ds = 5.3 + 8.8 = 14.1$

$Ho = 13.4'$

use RAY 1 of Refraction Analysis where Period = 8.1 sec and Azimuth is 330° (Angle Class 2) and depth = 14.39 (see Plot C)

$K_R = 1.0426$

$K_S = 1.0511$

$Hi = Ho\, K_R\, K_S = 14.68'$

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| COMPUTATION SHEET | DATE Feb 79 | PAGE 2A OF | FILE NUMBER |
|---|---|---|---|
| NAME OF OFFICE NCBED-DC | COMPUTATION Design wave | | |
| SUBJECT Geneva, OH small boat harbor | SOURCE DATA Plan-1 | | |
| COMPUTED BY J Pope | CHECKED BY 3/79 | APPROVED BY | |

$\frac{ds}{gT^2} = \frac{14.1}{(32.2)(8.1)^2} = .0067$ $m = 0.01$

$\frac{Hb}{ds} = 0.84$ (From Fig 7-4, SPM) $Hb = (0.84)(14.1) = 11.84'$

∴ Design wave is 11.8 breaking wave

DOGLEG TRUNK SECTION sounding = 8.'

$ds = 5.3 + 8 = 13.3$

$\frac{ds}{gT^2} = \frac{13.3}{(32.2)(8.1)^2} = .0063$ $m = 0.01$

$\frac{Hb}{ds} = 0.84$ (From Fig 7-4, SPM) $Hb = (0.84)(13.3) = 11.17'$

∴ Design wave is 11.2' breaking wave

TRUNK SECTION sounding = 6'

$ds = 5.3 + 6 = 11.3$

$\frac{ds}{gT^2} = \frac{11.3}{(32.2)(8.1)^2} = .0053$ $m = 0.01$

$\frac{Hb}{ds} = 0.85$ (Fig 7-4, SPM) $Hb = (0.85)(11.3) = 9.6'$

∴ Design wave is 9.6' breaking wave

INTERIOR BREAKWATER sounding = 1'

$ds = 5.3 + 1 = 6.3$

$\frac{ds}{gT^2} = \frac{6.3}{(32.2)(8.1)^2} = 0.003$ $m = 0.01$

$\frac{Hb}{ds} = 0.85$ $Hb = (0.85)(6.3) = 5.35'$

However with diffraction around the entrance channel structures the inner harbor will have no more than a 3' high wave. As a breaking wave is more severe than a non breaking wave and Lake level could drop below +2 LWD (where ds = 3) a breaking wave is assumed

∴ Design wave is 3' breaking wave

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| COMPUTATION SHEET | DATE Feb 79 | PAGE 3A OF | FILE NUMBER |
|---|---|---|---|

| NAME OF OFFICE NCBED -DC | COMPUTATION Stone Size |
|---|---|
| SUBJECT GENEVA, OH. small boat harbor | SOURCE DATA Plan-1 |

| COMPUTED BY J Pope | CHECKED BY 3/79 | APPROVED BY |
|---|---|---|

# PLAN 1 - STONE SIZES

EAST BREAKWATER

HEAD SECTION

$H_i = 9.9$ (breaking)

$$W = \frac{(155)(9.9)^3}{(2.9)(2.48-1)^3(1.5)} = 10,665 \text{ lbs}$$

ARMOR STONE

$W_{max} = 2.0(10665) = 21330 \text{ lb} = (10.7 \text{ TONS})$

$W_{min} = 0.9(10665) = 9599 \text{ lb} = (4.8 \text{ TONS})$

$r = (2)(1.15)\left(\frac{10665}{155}\right)^{1/3} = 9.4'$

UNDERLAYER STONE

$W_{max} = 0.2(W) = 2133 \text{ lbs}$

$W_{min} = 0.05(W) = 533 \text{ lbs}$

$r = (2)(1.15)\left(\frac{0.1(W)}{155}\right)^{1/3} = 4.4'$

BEDDING

$W_{max} = 0.01 W = 106.6 \text{ lbs}$

$W_{min} = 0.000125 W = 1.33 \text{ lbs}$

CREST WIDTH =

$B = (3)(1.15)\left(\frac{W}{155}\right)^{1/3} = 14.1'$

TRUNK SECTION $H_i = 7.9$ (breaking)

$$W = \frac{(155)(7.9)^3}{(3.5)(3.242)(1.5)} = 4490 \text{ lbs}$$

ARMOR STONE

$W_{max} = 2.0(W) = 8980 \text{ lbs} = (4.49 \text{ TONS})$

$W_{min} = 0.9(W) = 4041 \text{ lbs} = (2.02 \text{ TONS})$

$r = (2)(1.15)\left(\frac{W}{155}\right)^{1/3} = 7.1'$

UNDERLAYER STONE =

$W_{max} = 0.2 W = 898 \text{ lbs}$

$W_{min} = 0.05 W = 224 \text{ lbs}$

$r = (2)(1.15)\left(\frac{0.1 W}{155}\right)^{1/3} = 3.3'$

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1 APR 63

| COMPUTATION SHEET | DATE Feb 79 | PAGE 4A OF | FILE NUMBER |
|---|---|---|---|
| NAME OF OFFICE NCBED-DC | COMPUTATION Stone size | | |
| SUBJECT Geneva, OH. small boat harbor. | SOURCE DATA Plan-1 | | |
| COMPUTED BY J. Pope | CHECKED BY [initials] 3/79 | APPROVED BY | |

BEDDING

$W_{max} = 0.01W = 44.9$ lbs

$W_{min} = 0.000125W = 0.6$ lbs

CREST WIDTH

$B = (3)(1.15)\left(\frac{W}{155}\right)^{1/3} = 10.6'$

WEST BREAKWATER

HEAD SECTION $H_i = 11.8$ (breaking wave)

$$W = \frac{(155)(11.8)^3}{(2.9)(3.242)(1.5)} = 18058 \text{ lbs}$$

ARMOR STONE

$W_{max} = 2.0W = 36,116 = (18.06$ TONS$)$

$W_{min} = 0.9W = 16,252 = (8.13$ TONS$)$

$r = (2)(1.15)\left(\frac{W}{155}\right)^{1/3} = 11.2'$

UNDERLAYER STONE =

$W_{max} = 0.2W = 3612$ lbs

$W_{min} = 0.05W = 903$ lbs

$r = (2)(1.15)\left(\frac{0.1W}{155}\right)^{1/3} = 5.2'$

BEDDING

$W_{max} = 0.01W = 180.6$ lbs

$W_{min} = 0.000125W = 2.26$ lbs

CREST WIDTH

$B = (3)(1.15)\left(\frac{W}{155}\right)^{1/3} = 16.8'$

DOG LEG TRUNK SECTION $H_i = 11.2'$ (breaking wave)

$$W = \frac{(155)(11.2)^3}{(3.5)(3.242)(1.5)} = 12,794 \text{ lbs}$$

ARMOR STONE

$W_{max} = 2.0W = 25,588$ lbs $= (12.79$ TONS$)$

$W_{min} = 0.9W = 11,515$ lbs $= (5.76$ TONS$)$

$r = (2)(1.15)\left(\frac{W}{155}\right)^{1/3} = 10.0'$

UNDERLAYER STONE

$W_{max} = 0.2W = 2559$ lbs

$W_{min} = 0.05W = 640$ lbs

$r = (2)(1.15)\left(\frac{0.1W}{155}\right)^{1/3} = 4.6'$

| COMPUTATION SHEET | DATE Feb 79 | PAGE 5A OF | FILE NUMBER |
|---|---|---|---|

| NAME OF OFFICE | COMPUTATION |
|---|---|
| NCBED-DC | STONE SIZE |
| SUBJECT: Geneva, OH. small boat harbor. | SOURCE DATA: Plan-1 |

| COMPUTED BY | CHECKED BY | APPROVED BY |
|---|---|---|
| J. Pope | 3/79 | |

BEDDING

$W_{max} = 0.01W = 128$ lbs

$W_{min} = 0.000125W = 1.6$ lbs

CREST WIDTH

$B = (3)(1.15)(\frac{W}{155})^{1/3} = 15.0'$

TRUNK SECTION $\quad H_i = 9.6'$ (breaking wave)

$$W = \frac{(155)(9.6)^3}{(3.5)(3.242)(1.5)} = 8,057 \text{ lbs}$$

ARMOR STONE

$W_{max} = 2.0W = 16,114$ lbs $= (8.06$ TONS$)$

$W_{min} = 0.9W = 7,251$ lbs $= (3.63$ TONS$)$

$r = (2)(1.15)(\frac{W}{155})^{1/3} = 8.6'$

UNDERLAYER STONE

$W_{max} = 0.2W = 1611$ lbs

$W_{min} = 0.05W = 403$ lbs

$r = (2)(1.15)(\frac{0.1W}{155})^{1/3} = 4.0'$

BEDDING

$W_{max} = 0.01W = 80.6$ lbs

$W_{min} = 0.000125W = 1$ lbs

CREST WIDTH

$B = (3)(1.15)(\frac{W}{155})^{1/3} = 12.9'$

INTERIOR BREAKWATER $\quad H_i = 3'$ (breaking) (design for head)

$$W = \frac{(155)(3)^3}{(2.9)(3.242)(1.5)} = 298 \text{ lbs}$$

ARMOR STONE

$W_{max} = 2.0W = 593$ lbs $= (0.30$ TONS$)$

$W_{min} = 0.9W = 267$ lbs

$r = (2)(1.15)(\frac{W}{155})^{1/3} = 2.9'$

UNDERLAYER

$W_{max} = 0.2W = 59$ lbs

$W_{min} = 0.05W = 15$ lbs

$r = (2)(1.15)(\frac{0.1W}{155})^{1/3} = 1.3'$

CREST WIDTH

$B = (3)(1.15)(\frac{W}{155})^{1/3} = 4.4'$

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| COMPUTATION SHEET | DATE March 79 | PAGE 6A OF | FILE NUMBER |
|---|---|---|---|
| NAME OF OFFICE NCBED-DC | COMPUTATION Crest Height | | |
| SUBJECT Geneva, OH. small boat harbor | SOURCE DATA Plan 1 | | |
| COMPUTED BY Pope | CHECKED BY [illegible] 3/79 | APPROVED BY | |

# PLAN 1 - CREST HEIGHT

EAST BREAKWATER HEAD SECTION

$d_s = 11.8'$ $H_o = 9.8$ $H_b = 9.9'$ $T_o = 7.2$

$L_o = 5.12(7.2)^2 = 265.4$ $\frac{d_s}{L_o} = \frac{11.8}{265.4} = .0445$

$H/H_o' = 1.044$ (Table C-1, SPM) $H_o' = \frac{9.8}{1.044} = 9.5'$

$T_o = 7.1$

$\frac{H_o'}{gT^2} = \frac{9.5'}{(32.2)(7.1)^2} = 0.0059$ $\frac{d_s}{H_o'} = \frac{11.8}{9.5} = 1.24$ $\cot\theta = 1.5$

$\frac{R}{H_o} = 2.6$ for $d_s/H_o = 0.8$ (Fig 7-10, SPM)

$\frac{R}{H_o} = 2.45$ for $d_s/H_o = 2.0$ (Fig 7-11, SPM)

$R/H_o = 2.55$ for $d_s/H_o = 1.2$ (Interpolated)

$R = (H_o')(2.55) = 24.23$ (Runup - smooth)

SCALE CORRECTION FACTOR = 1.206 (Fig 7-13, SPM)

$\left[\frac{R}{H_o}\right]_{riprap} = 1.15$ (Fig 7-15, SPM) $\frac{\left[\frac{R}{H_o}\right]_{riprap}}{\left[\frac{R}{H_o}\right]_{smooth}} = \frac{1.15}{2.55} = .451$

$R_{riprap} = (1.206)(24.23)(.451) = 13.2'$

THIS RUNUP IS BASED ON A LAKESHORE SLOPE OF m=1:10. THE LAKESHORE SLOPE AT THE PROJECT SITE IS m=1:100, THEREFORE GODA CURVES were used to correct the Riprap RUNUP VALUE (ref NCDED-C letter of 22 AUG 1978)

$\frac{d_s}{H_o} = 1.24$ $\frac{H_o'}{L_o} = \frac{9.5}{(5.12)(7.1)^2} = .037$

for m = 1:10 $H/H_o' = 1.04$ ratio $= \frac{0.77}{1.04} = 0.74$

for m = 1:100 $H/H_o' = 0.77$

ACTUAL RUN UP = 0.74R = (0.74)(13.2) = 9.8'

CREST HEIGHT is found using Cross & Sollitt Method

$K_T = 0.54(1.04 - H_{bi}/R) = \frac{H_T}{H_i}$

$H_{bi} = R\left(1.04 - \frac{H_T}{0.54 H_i}\right) = 9.8\left(1.04 - \frac{3}{(0.54)(9.9)}\right) = 4.7'$

CREST HEIGHT = 4.7' + 5.3 = 10.0

∴ Crest height is +10 feet above LWD meets design criterion of a 3.0' foot maximum interior wave in the entrance channel.

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| COMPUTATION SHEET | DATE March 79 | PAGE 7A OF | FILE NUMBER |
|---|---|---|---|
| NAME OF OFFICE NCBED-DC | | COMPUTATION Crest Height | |
| SUBJECT Geneva, OH. small boat harbor. | | SOURCE DATA F C?-1 | |
| COMPUTED BY Pope | CHECKED BY 3/79 | | APPROVED BY |

EAST BREAKWATER TRUNK SECTION)

$ds = 9.3$ $H_o = 9.8'$ $H_b = 7.9'$ $T_o = 7.2$
(same as year round)

$L_o = 5.12(7.2)^2 = 265.4$ $\frac{ds}{L_o} = \frac{9.3}{265.4} = 0.035$

$H/H_o' = 1.092$ (Table C-1, SPM) $H_o' = \frac{7.9}{1.092} = 7.2$ $T_o' = 6.4$

$\frac{H_o}{gT^2} = \frac{7.2}{(32.2)(6.4)^2} = .0055$ $\frac{ds}{H_b} = \frac{9.3}{7.2} = 1.29$ $\cot\theta = 1.5$

$\frac{R}{H_o'} = 2.7$ for $ds/H_o' = 0.8$ (Fig 7-10, SPM)

$\frac{R}{H_o'} = 2.55$ for $ds/H_o' = 2.0$ (Fig 7-11, SPM)

$\frac{R}{H_o'} = 2.65$ for $ds/H_o' = 1.3$ (Interpolated)

$R = (H_o')(\frac{R}{H_o'}) = (7.2)(2.65) = 19.1'$

SCALE CORRECTION FACTOR = 1.206 (Fig 7-13, SPM)

$\left[\frac{R}{H_o}\right]_{riprap} = 1.2$ (Fig 7-15, SPM) $\frac{\left[\frac{R}{H_o}\right]_{riprap}}{\left[\frac{R}{H_o}\right]_{smooth}} = \frac{1.2}{2.65} = 0.453$

$R_{riprap} = (1.206)(19.1)(0.453) = 10.4'$

This RUNUP is based on a Lakeshore slope of m=1:10. The lakeshore slope at the project site is m=1:100, therefore GODA CURVES were used to correct the riprap runup calculation (ref NCDED-C letter of 22 Aug 1978)

$\frac{ds}{H_o} = 1.29$ $\frac{H_o'}{L_o} = \frac{7.2}{(5.12)(6.4)^2} = .034$

for m = 1:10 $H/H_o' = 1.05$
for m = 1:100 $H/H_o' = 0.805$ ratio $= \frac{0.805}{1.05} = 0.77$

ACTUAL RUN-UP = 0.77 R = (0.77)(10.4) = 8.0'

CREST HEIGHT is found using Cross + Sollitt Method

$H_{bt} = 8.0\left(1.04 - \frac{3}{(0.54)(7.9)}\right) = 2.7'$

CREST HEIGHT = 2.7' + 5.3' = 8'

∴ CREST of 8' above LWD is needed to meet design criterion of a 3.0' maximum interior wave in the entrance channel.

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1 APR 63

| COMPUTATION SHEET | DATE March 79 | PAGE 8A OF | FILE NUMBER |
|---|---|---|---|
| NAME OF OFFICE NCBED-DC | COMPUTATION Crest Height | | |
| SUBJECT Geneva, OH. small boat harbor | SOURCE DATA Plan-1 | | |
| COMPUTED BY Pope | CHECKED BY 3/79 | APPROVED BY | |

**WEST BREAKWATER HEAD SECTION**

$d_s = 14.1$ $\quad H_o = 12.1'$ $\quad H_b = 11.8$ $\quad (T_o = 7.8)$

Angle Class 2 - boating season

$L_o = 5.12(7.8)^2 = 311.5$ $\quad \frac{d_s}{L_o} = \frac{14.1}{311.5} = .0453$ $\quad H/H_o' = 1.041$ (Table C-1, SPM)

$H_o' = \frac{11.8}{1.041} = 11.3$ $\quad T_o' = 7.6$

$\frac{H_o'}{gT^2} = \frac{11.3}{(32.2)(7.6)^2} = .0061$ $\quad \frac{d_s}{H_o'} = \frac{14.1}{11.3} = 1.25$ $\quad \cot\theta = 1.5$

$\frac{R}{H_o} = 2.6$ for $d_s/H_o = 0.8$ (Fig 7-10, SPM)

$\frac{R}{H_o} = 2.45$ for $d_s/H_o = 2.0$ (Fig 7-11, SPM)

$R/H_o = 2.55$ for $d_s/H_o = 1.25$ (Interpolated)

$R = (H_o')(2.55) = 28.8'$

SCALE CORRECTION FACTOR = 1.206 (Fig 7-13, SPM)

$\left[\frac{R}{H_o}\right]_{riprap} = 1.2$ (Fig 7-15 SPM) $\quad \frac{\left[\frac{R}{H_o}\right]_{riprap}}{\left[\frac{R}{H_o}\right]_{smooth}} = \frac{1.2}{2.55} = .471$

$R_{riprap} = (0.471)(28.8)(1.206) = 16.4'$

This runup is based on a Lakeshore slope of m = 1:10. The lakeshore slope at the project site is m = 1:100, therefore GODA CURVES were used to correct the riprap runup calculation (ref NCDED-C letter of 22 AUG 1978).

$\frac{d_s}{H_o} = 1.25$ $\quad \frac{H_o'}{L_o} = \frac{11.3}{(5.12)(7.6)^2} = .038$

for m = 1:10 $\quad H/H_o' = 1.04$

for m = 1:100 $\quad H/H_o' = 0.78$ $\quad$ ratio $= \frac{0.78}{1.04} = 0.75$

ACTUAL RUN-UP = 0.7 R = $(0.75)(16.4) = 12.3'$

CREST HEIGHT is found using Cross + Sollitt Method

$H_{b_i} = 12.3\left(1.04 - \frac{3}{(0.54)(11.8)}\right) = 7.0'$

CREST HEIGHT = $7.0' + 5.3' = 12.3'$ above LWD in order to meet the design criterion of a 3.0' maximum interior wave in the entrance channel.

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| COMPUTATION SHEET | DATE March 79 | PAGE 9A OF | FILE NUMBER |
|---|---|---|---|
| NAME OF OFFICE NCBED-DC | | COMPUTATION Crest Height | |
| SUBJECT Geneva, OH. small boat harbor | | Plan-1 | |
| COMPUTED BY Pope | CHECKED BY [illegible] 3/79 | | APPROVED BY |

WEST BREAKWATER DOGLEG TRUNK SECTION

As design wave for boating season is 11.2 breaking wave which is close to the Hb of 11.8 which was used for the head section - will assume the same crest height of 12.3 for the Dog Leg Trunk Section.

WEST BREAKWATER TRUNK SECTION

$ds = 11.3$ $Hb = 9.6'$ breaking wave (boat season Angle Class 2-3 wave = 12.1) $T_o = 7.1$ $L_o = 5.12(7.1)^2 = 258.$

$ds/L_o = 11.3/258.1 = 0.0438$ $H/H_o' = 1.047$ (Table C-1, SPM) $H_o' = 9.6/1.047 = 9.2'$

$\frac{H_o'}{gT^2} = \frac{9.2}{(32.2)(7.0)^2} = .0058$ $\frac{ds}{H_o'} = \frac{11.3}{9.2} = 1.23$ $T_o' = 7.0$ $\cot\theta = 1.5$

$R/H_o = 2.75$ for $ds/H_o = 0.8$ (Fig 7-10, SPM)

$R/H_o = 2.55$ for $ds/H_o = 2.0$ (Fig 7-11, SPM)

$R/H_o = 2.68$ for $ds/H_o = 1.23$ (Interpolated)

$R_{smooth} = (H_o')(\frac{R}{H_o}) = (9.2)(2.68) = 24.7'$

SCALE CORRECTION FACTOR = 1.206 (Fig 7-13, SPM)

$\left[\frac{R}{H_o}\right]_{riprap} = 1.2$ (Fig 7-15, SPM) $\frac{[R/H_o]_{riprap}}{[R/H_o]_{smooth}} = \frac{1.2}{2.68} = 0.448$

$R_{riprap} = (24.7)(1.206)(0.448) = 13.3'$

This runup is based on a lakeshore slope of m = 1:10. The lakeshore slope at the project site is m = 1:100, therefore GODA CURVES were used to correct the riprap runup calculation (ref NCDED-C letter of 22 Aug 78)

$\frac{ds}{H_o} = 1.23$ $\frac{H_o'}{L_o} = \frac{9.2}{(5.12)(7.0)^2} = .037$

for m = 1:10 $H/H_o = 1.04$
for m = 1:100 $H/H_o = 0.795$ ratio $= \frac{0.775}{1.04} = 0.745$

ACTUAL RUN-UP = 0.745 (13.3) = 9.9'

CREST HEIGHT is found using Cross & Sollitt method

$Hb_i = 9.9\left(1.04 - \frac{3}{(0.54)(9.6)}\right) = 4.6$

CREST HEIGHT = 4.6 + 5.3 = 9.9' above LWD in order to meet design criterion of a 3.0' maximum interior wave in the entrance channel.

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| COMPUTATION SHEET | DATE March 79 | PAGE 10A OF | FILE NUMBER |
|---|---|---|---|
| NAME OF OFFICE NCBED-DC | COMPUTATION Crest Height | | |
| SUBJECT Geneva, OH. small boat harbor | Plan - 1 | | |
| COMPUTED BY Pope | CHECKED BY 3/79 | APPROVED BY | |

INTERIOR BREAKWATER

$ds = 6.3 \quad Hb = 3' \quad T = 4.5'$

$Lo = 5.12(4.5)^2 = 103.7 \quad ds/Lo = 6.3/103.7 = .0608 \quad \cot\theta = 1.5$

$H/H_o' = .9907$ (Table C-1, SPM) $\quad H_o' = 3/.9907 = 3.03'$

$H_o'/gT^2 = 3.03/32.2(4.5)^2 = 0.0046 \quad ds/H_o = 6.3/3.03 = 2.08$

$R/H_o = 2.60$ for $ds/H_o \geq 2.0$ (Fig 7-11, SPM)

$R = (H_o)(R/H_o) = (3)(2.60) = 7.8'$

SCALE CORRECTION FACTOR = 1.166 (Fig 7-13, SPM)

$\left[\frac{R}{H_o}\right]_{riprap} = 1.1$ (Fig 7-15 SPM) $\quad \frac{[R/H_o]_{riprap}}{[R/H_o]_{smooth}} = \frac{1.1}{2.60} = .423$

$R_{riprap} = (0.423)(1.166)(7.8)' = 3.85'$

This runup is based on a Lakeshore slope of m=1:10. The lakeshore slope at the project site is m=1:100, therefore GODA CURVES were used to correct the riprap runup calculation (ref NCDED-C letter of 22 Aug 1978).

$\frac{ds}{H_o} = 2.1 \qquad \frac{H_o'}{Lo} = \frac{3}{(5.12)(4.5)^2} = .029$

for m=1:10 $\quad H/H_o = 1.0$

for m=1:100 $\quad H/H_o = 0.93$

ratio $= \frac{0.93}{1.0} = 0.93$

ACTUAL RUNUP = 0.93 (3.85') = 3.6'

CREST HEIGHT is found using Cross + Sollitt Method

$Hb_i = 3.6\left(1.04 - \frac{1.0}{0.54(3)}\right) = 1.5'$

CREST HEIGHT = 1.5' + 5.3 = 6.8' above LWD in order to meet design criterion of a 1.0' maximum interior wave in the mooring basin.

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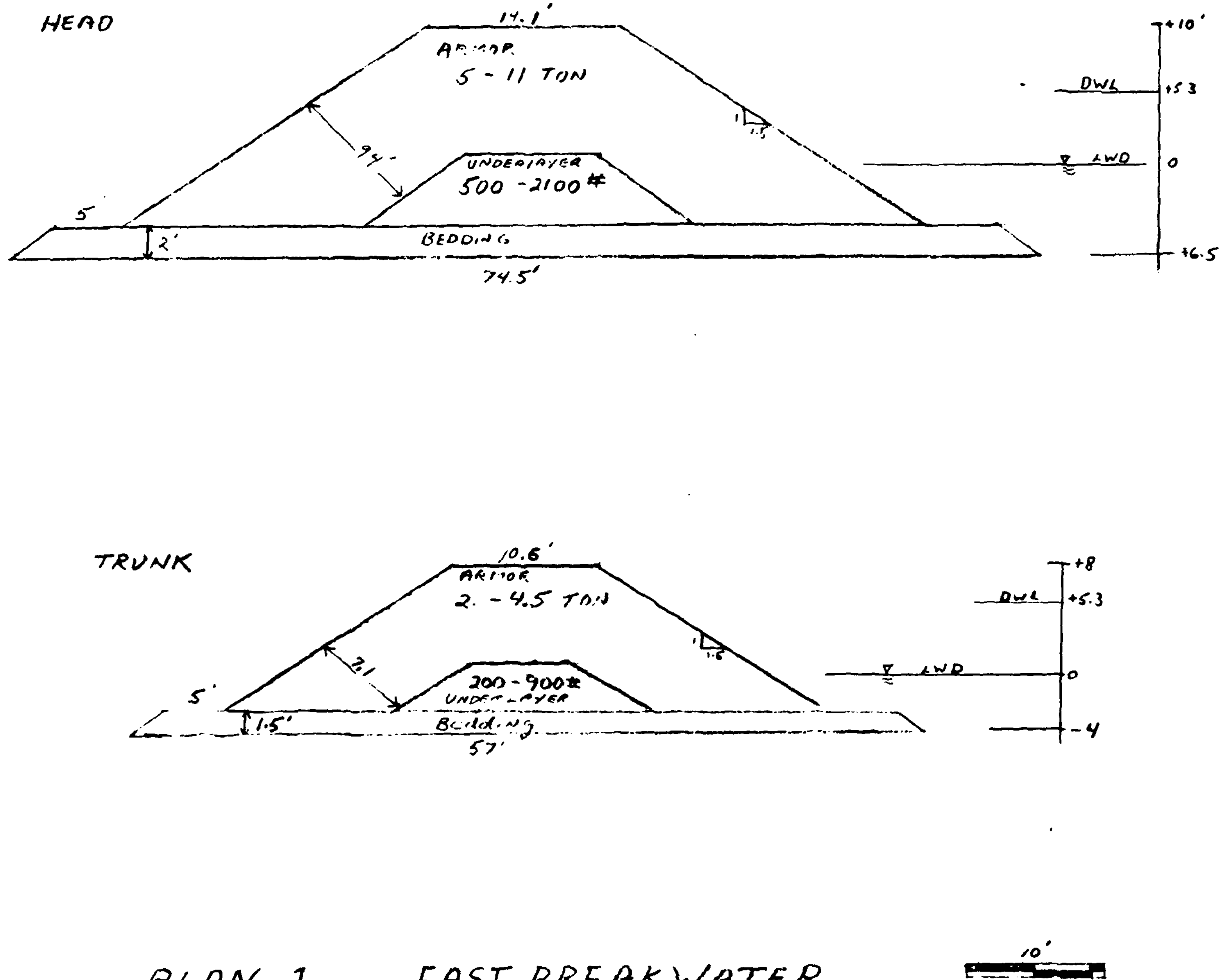
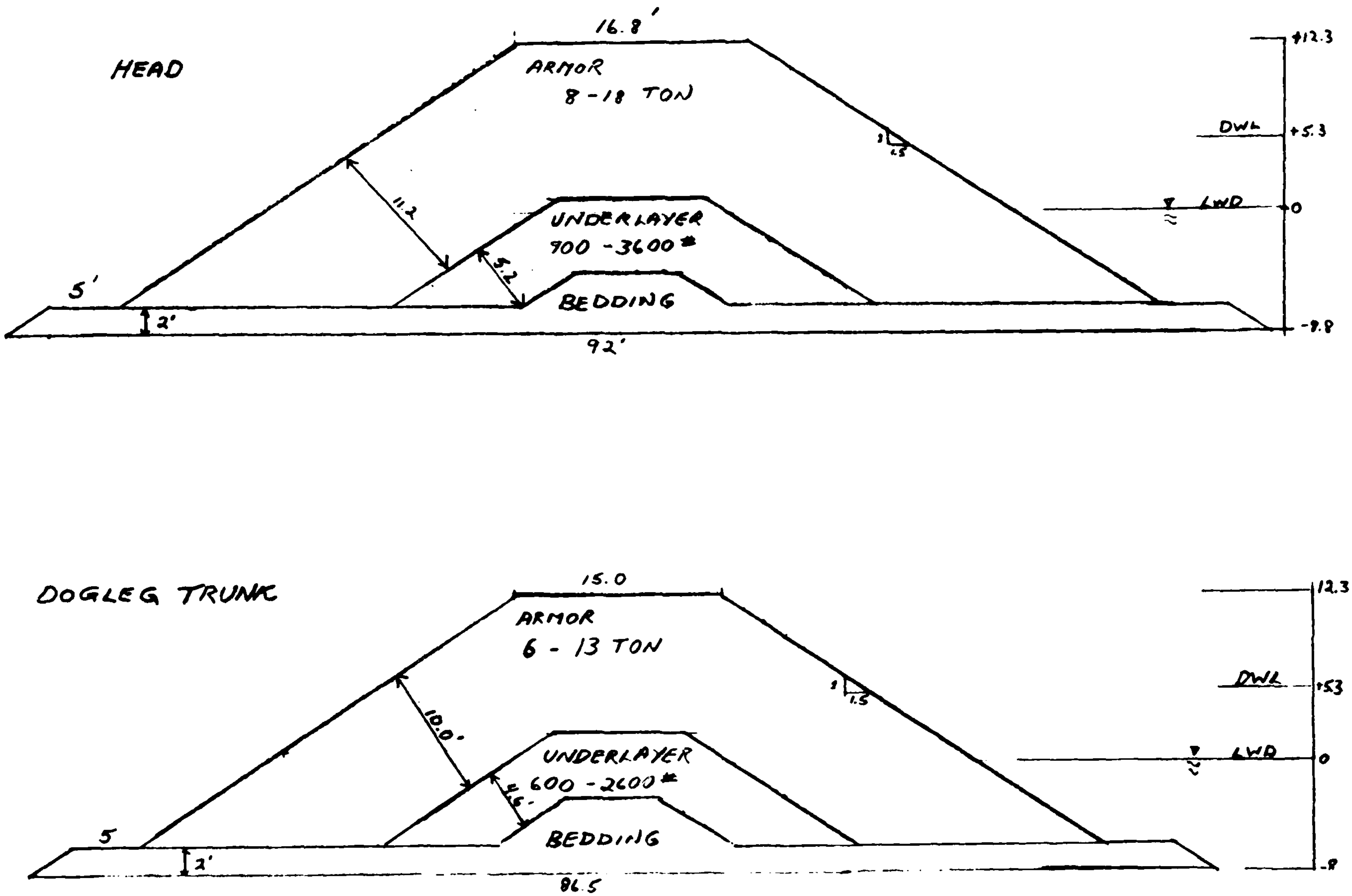


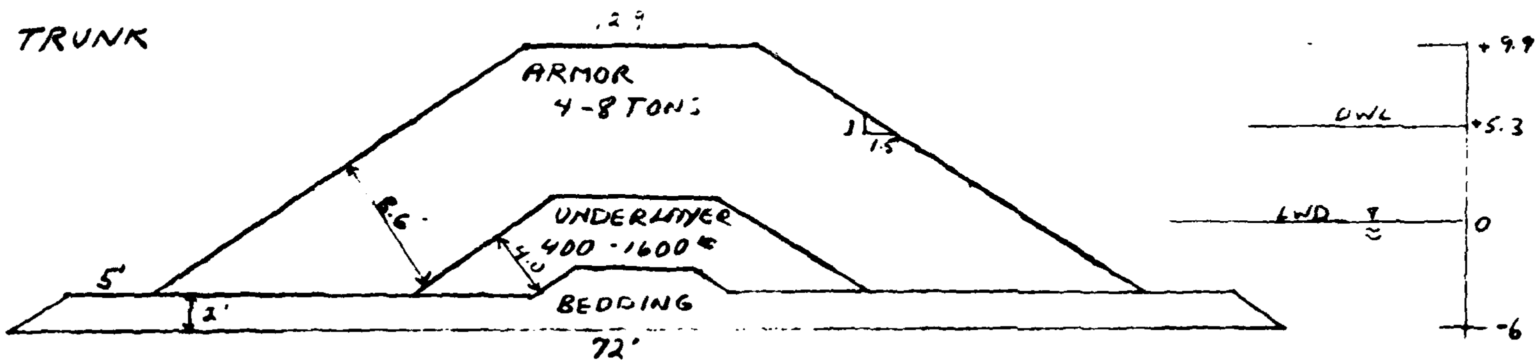

PLAN 1 EAST BREAKWATER

NCBED-DC/JP/March 1979

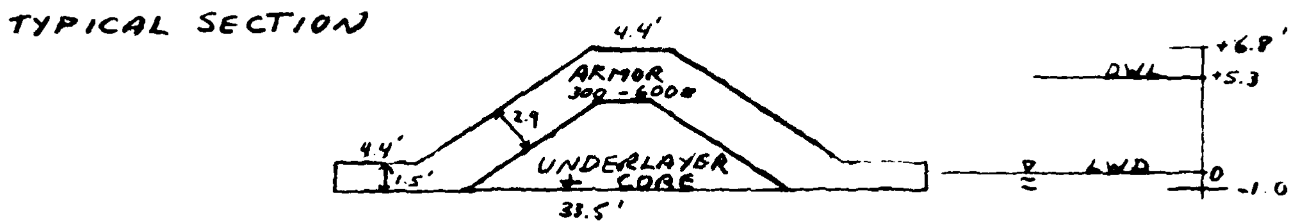



PLAN 1 - WEST BREAKWATER

NCBED-DC/JP/MARCH 7




PLAN 1 - WEST BREAKWATER




PLAN I - INTERIOR BREAKWATER

| COMPUTATION SHEET | DATE Feb 79 | PAGE 18 OF | FILE NUMBER |
|---|---|---|---|
| NAME OF OFFICE NCBED-DC | COMPUTATION Design wave | | |
| SUBJECT Geneva, OH. small boat harbor | SOURCE DATA Plan - 2 | | |
| COMPUTED BY J Pope | CHECKED BY 3/79 | APPROVED BY | |

REO PLAN 2 - Design wave for stone size

EAST BREAKWATER

HEAD SECTION sounding = 11.5'

$d_s = 5.3 + 11.5 = 16.8$

$H_o = 13.1$

use RAY 21 of Refraction Analysis where period = 9.4 sec and Azimuth is 270° (Angle class 3) and depth = 16.53 (see PLOTE)

$K_R = .948$

$K_s = 1.0826$

$H_i = H_o K_R K_s = 13.4$

$\frac{d_s}{gT^2} = \frac{16.8}{(32.2)(9.4)^2} = .0059$ $m = 0.01$

$\frac{H_b}{d_s} = 0.85$ (Fig 7-4, SPM) $H_b = (0.85)(16.8) = 14.3$

∴ Design wave is 13.4' Non-breaking

TRUNK SECTION sounding = 8'

$d_s = 5.3 + 8. = 13.3$

$H_o = 9.8'$

use RAY 14 of Refraction Analysis where Period = 7.2 and Azimuth is 30° (Angle class 1) and depth = 15.05 (see PLOT A)

$K_R = .9427$

$K_s = 1.0020$

$H_i = H_o K_R K_s = 9.26'$

$\frac{d_s}{gT^2} = \frac{13.3}{(32.2)(7.2)^2} = .008$ $m = 0.01$

$\frac{H_b}{d_s} = 0.83$ (Fig 7-4, SPM $H_b = (0.83)(13.3) = 11.04$

∴ Design wave is 9.26' Non-breaking

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1 APR 63

| COMPUTATION SHEET | DATE Feb 79 | PAGE 28 OF | FILE NUMBER |
|---|---|---|---|

| NAME OF OFFICE NCBED-DC | COMPUTATION Design wave |
|---|---|
| SUBJECT Geneva, OH small boat harbor | SUBJECT DATA Plan-2 |
| COMPUTED BY J Pope | CHECKED BY 3/79 |
| APPROVED BY | |

WEST BREAKWATER

HEAD SECTION sounding = 10.8'

$ds = 5.3 + 10.8 = 16.1'$

$Ho = 13.1'$

USE RAY 22 of Refraction Analysis where period = 9.4 sec and Azimuth is 270° (Angle class 3) and depth = 17.26' (see PLOT E)

$K_R = 0.9542$

$K_S = 1.0737$

$H_i = H_o K_R K_S = 13.4$

∴ Design wave = 13.4' Non-breaking

GENERAL TRUNK SECTION sounding = 6'

$ds = 5.3 + 6 = 11.3$

$Ho = 13.4$

use RAY 22 of Refraction Analysis where period = 8.1 sec and Azimuth is 330° (Angle Class 2) and depth = 12.36' (see plot C)

$K_R = .8320$

$K_S = 1.0812$

$H_i = H_o K_R K_S = 12.05'$

$\frac{ds}{gT^2} = \frac{11.3}{(32.2)(8.1)^2} = .0053$ $m = 0.01$

$\frac{Hb}{ds} = 0.85$ (Fig 7-4, SPM) $Hb = (0.85)(11.3) = 9.6'$

∴ Design wave is 9.6' breaking wave

SAND TRAP BREAKWATER sounding = 4'

$ds = 5.3 + 4 = 9.3'$

$\frac{ds}{gT^2} = \frac{9.3}{(32.2)(8.1)^2} = .0044$ $m = 0.01$

$\frac{Hb}{ds} = 0.85$ (Fig 7-4, SPM) $Hb = (0.85)(9.3) = 7.9'$

∴ Design wave is 7.9' breaking wave

NCD Form 14 1 APR 63 Previous edition may be used until supply is exhausted.

| COMPUTATION SHEET | DATE Feb 79 | PAGE 38 OF | FILE NUMBER |
|---|---|---|---|
| NAME OF OFFICE NCBED-DC | COMPUTATION stone size | | |
| SUBJECT Geneva, OH. small boat harbor | SOURCE DATA Plan-2 | | |
| COMPUTED BY J. Pope | CHECKED BY (initials) 3/79 | APPROVED BY | |

# PLAN 2 - STONE SIZES

<u>EAST BREAKWATER HEAD SECTION</u> $H_i$ = 13.4' (non breaking)

$$W = \frac{(155)(13.4)^3}{(3.2)(3.242)(1.5)} = 23{,}966 \text{ lbs}$$

ARMOR STONE

$W_{max} = 2.0(w) = 47{,}932 = (23.97 \text{ TONS})$

$W_{min} = 0.9(w) = 21{,}569 = (10.78 \text{ TONS})$

$r = (2)(1.15)\left(\frac{W}{155}\right)^{1/3} = 12.3'$

UNDERLAYER STONE

$W_{max} = 0.2(w) = 4793$ lbs

$W_{min} = 0.05(w) = 1198$ lbs

$r = (2)(1.15)\left(\frac{0.1W}{155}\right)^{1/3} = 5.7'$

BEDDING

$W_{max} = 0.01W = 239.7$ lbs

$W_{min} = 0.000125W = 3.0$ lbs

CREST WIDTH

$B = (3)(1.15)\left(\frac{W}{155}\right)^{1/3} = 18.5$

<u>TRUNK SECTION</u> $H_i$ = 9.3' (non-breaking)

$$W = \frac{(155)(9.3)^3}{(4.0)(3.242)(1.5)} = 6409$$

ARMOR STONE

$W_{max} = 2.0(w) = 12{,}819$ lbs $= (6.41 \text{ TONS})$

$W_{min} = 0.9(w) = 5{,}768$ lbs $= (2.88 \text{ TONS})$

$r = (2)(1.15)\left(\frac{W}{155}\right)^{1/3} = 8.0'$

UNDERLAYER STONE

$W_{max} = 0.2W = 1282$ lbs

$W_{min} = 0.05W = 320$ lbs

$r = (2)(1.15)\left(\frac{0.1W}{155}\right)^{1/3} = 3.7'$

BEDDING

$W_{max} = 0.01W = 64.1$ lbs

$W_{min} = 0.000125W = 0.8$ lbs

CREST WIDTH

$B = (3)(1.15)\left(\frac{W}{155}\right)^{1/3} = 11.9'$

| COMPUTATION SHEET | DATE Feb 79 | PAGE 4B OF | FILE NUMBER |
|---|---|---|---|
| NAME OF OFFICE NCBED-DC | COMPUTATION stone size | | |
| SUBJECT Geneva, OH. small boat harbor. | SOURCE DATA Plan-2 | | |
| COMPUTED BY J Pope | CHECKED BY [illegible] 3/79 | APPROVED BY | |

WEST BREAKWATER HEAD SECTION $H_i = 13.4$ (non breaking)

SAME SIZE STONE AS EAST BREAKWATER HEAD SECTION

GENERAL TRUNK SECTION $H_i = 9.6'$ (breaking wave)

$$W = \frac{(155)(9.6)^3}{(3.5)(3.242)(1.5)} = 8,057$$

ARMOR STONE

$W_{max} = 2.0W = 16,114$ lbs $= (8.06$ TONS$)$

$W_{min} = 0.9W = 7,251$ lbs $= (3.63$ TONS$)$

$r = (2)(1.15)\left(\frac{W}{155}\right)^{1/3} = 8.6'$

UNDERLAYER STONE

$W_{max} = 0.2W = 1611$ lbs

$W_{min} = 0.05W = 403$ lbs

$r = (2)(1.15)\left(\frac{0.1W}{155}\right)^{1/3} = 4.0'$

BEDDING

$W_{max} = 0.01W = 80.6$ lbs

$W_{min} = 0.000125W = 1.0$ lb

CREST WIDTH

$B = (3)(1.15)\left(\frac{W}{155}\right)^{1/3} = 12.9'$

SAND TRAP BREAKWATER $H_i = 7.9'$ breaking wave design for head

$$W = \frac{(155)(7.9)^3}{(2.9)(3.242)(1.5)} = 5419 \text{ lbs}$$

ARMOR STONE

$W_{max} = 2.0W = 10,838$ lbs $= (5.42$ TONS$)$

$W_{min} = 0.9W = 4,877$ lbs $= (2.44$ TONS$)$

$r = (2)(1.15)\left(\frac{W}{155}\right)^{1/3} = 7.5'$

UNDERLAYER

$W_{max} = 0.2W = 1084$ lbs

$W_{min} = 0.05W = 271$ lbs

$r = (2)(1.15)\left(\frac{0.1W}{155}\right)^{1/3} = 3.5'$

BEDDING

$W_{max} = 0.01W = 54.2$ lbs

$W_{min} = 0.000125W = 0.7$ lb.

CREST WIDTH $B = (3)(1.15)\left(\frac{W}{155}\right)^{1/3} = 11.3$

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| COMPUTATION SHEET | DATE March 1979 | PAGE 58 OF | FILE NUMBER |
|---|---|---|---|
| NAME OF OFFICE NCBED-DC | COMPUTATION CREST HEIGHT - | | |
| SUBJECT Geneva, OH. Small boat harbor | SOURCE DATA Plan 2 | | |
| COMPUTED BY Pope | CHECKED BY 3/79 | APPROVED BY | |

PLAN 2 - CREST HEIGHT

EAST BREAKWATER HEAD SECTION

$ds = 16.8'$ $H_o = 12.1$ Angle class 3 - boating season $T_o = 9.0$

use RAY 21 of Refraction Analysis where $T_o = 9.0$ and Azimuth = 270° and depth = 16.62 (see Point D)

$K_R = .9480$ $K_s = 1.0639$ $H_c = H_o K_R K_s = 12.2'$ $H_o' = H_o K_R = 11.5$ $T_o = 8.8$

$\frac{H_o'}{gT^2} = \frac{11.5}{(32.2)(8.8)^2} = .0046$ $\frac{ds}{H_o} = \frac{16.8}{11.5} = 1.46$ $\cot\theta = 1.5$

$R/H_o = 2.92$ for $ds/H_o = 0.8$ (Fig 7-10, SPM)

$R/H_o = 2.60$ for $ds/H_o = 2.0$ (Fig 7-11, SPM)

$R/H_o = 2.74$ for $ds/H_o = 1.46$ (Interpolated)

$R = (H_o')(2.74) = 31.5'$ smooth

SCALE CORRECTION FACTOR = 1.206 (Fig 7-13, SPM)

$\left[\frac{R}{H_o}\right]_{riprap} = 1.2$ (Fig 7-15 SPM) $\frac{[R/H_o]_{riprap}}{[R/H_o]_{smooth}} = \frac{1.2}{2.74} = 0.438$

$R_{riprap} = (1.206)(0.438)(31.5) = 16.6$

This runup is based on a lakeshore slope of m=1:10. The lakeshore slope at the project site is m=1:100, therefore GODA CURVES were used to correct the riprap runup calculation (ref NCDED-C letter of 22 Aug 78)

$\frac{ds}{H_o} = 1.46$ $\frac{H_o'}{L_o} = \frac{11.5}{(5.12)(8.8)^2} = 0.29$

for $M = 1:10$ $H/H_o' = 1.05$
for $m = 1:100$ $H/H_o' = 0.90$ ratio = $\frac{0.90}{1.05} = .86$

ACTUAL RUN-UP = $(0.86)R = 14.3'$

CREST HEIGHT is found using Cross + Sollitt Method

$H_{bi} = 14.3\left(1.04 - \frac{2.0}{(0.54)(12.2)}\right) = 8.4$

CREST HEIGHT = $8.4 + 5.3 = 13.7$ above LWD in order to meet design criterion of a 3.0' maximum interior wave in the entrance channel.

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|---|---|---|---|
| NAME OF OFFICE NCBED-DC | COMPUTATION CREST HEIGHT | | |
| SUBJECT Geneva, OH. small boat harbor | SOURCE DATA Plan. 2 | | |
| COMPUTED BY Pope | CHECKED BY [illegible] 3/79 | APPROVED BY | |

EAST BREAKWATER TRUNK SECTION

$d_s = 13.3$ $H_o = 9.8'$

Angle class 2 - boating season - same as year round

From refraction analysis, pg 1B, $H_i = 9.3$ $H_o' = H_o K_R = 9.2$ $T_o' = 7.0$

$\frac{H_o'}{gT^2} = \frac{9.2}{(32.2)(7.0)^2} = .0058$ $\frac{d_s}{H_o'} = \frac{13.3}{9.2} = 1.45$ $\cot\theta = 1.5$

$R/H_o' = 2.7$ for $d_s/H_o' = 0.8$ (Fig 7-10, SPM)

$R/H_o' = 2.45$ for $d_s/H_o' = 2.0$ (Fig 7-11, SPM)

$R/H_o' = 2.57$ for $d_s/H_o' = 1.45$ (Interpolated)

$R = (9.2)(2.57) = 23.6$

SCALE CORRECTION FACTOR = 1.206 (Fig 7-13, SPM)

$\left[\frac{R}{H_o'}\right]_{riprap} = 1.2$ (Fig 7-15, SPM) $\frac{[R/H_o']_{riprap}}{[R/H_o']_{smooth}} = \frac{1.2}{2.57} = 0.467$

$R_{riprap} = (1.206)(0.467)(23.6) = 13.3'$

This runup is based on a lakeshore slope of m = 1:10. The lakeshore slope at the project site is m = 1:100, therefore GODA CURVES were used to correct the riprap runup calculation (ref NCDED-C letter of 22 Aug 78)

$\frac{d_s}{H_o'} = 1.45$ $\frac{H_o'}{L_o} = \frac{9.2}{(5.12)(7.0)^2} = .037$

for m = 1:10 $H/H_o' = 1.02$

for m = 1:100 $H/H_o' = 0.87$ ratio = $\frac{0.87}{1.02} = 0.853$

ACTUAL RUN-UP = $(0.853)(13.3') = 11.3'$

CREST HEIGHT is found using Cross + Sollitt Method

$$H_{bc} = 11.3'\left(1.04 - \frac{1.0}{(0.54)(9.3)}\right) = 9.5'$$

CREST HEIGHT = $9.5' + 5.3' = 14.8'$ above LWD in order to meet design criterion of a 1.0' maximum interior wave in the mooring basin.

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|---|---|---|---|
| NAME OF OFFICE NCBED-DC | COMPUTATION CREST HEIGHT | | |
| SUBJECT Geneva, small boat harbor. | SOURCE DATA Plan-2 | | |
| COMPUTED BY Pope | CHECKED BY 3/79 | APPROVED BY | |

WEST BREAKWATER ~~HEAD SECTION~~

$d_s = 16.1'$ $H_o = 12.1$ Angle Class 3 - boating season $T_o = 9.0$

use Ray 22 of Refraction Analysis where $T_o = 9.0$ and Azimuth $= 270°$ and depth $= 15.88$ (see APP D)

$K_R = 0.9466$ $K_s = 1.0730$ $H_i = H_o K_R K_s = 12.3$ $H_o' = H_o K_R = 11.5$ $T_o = 8.8$

$\frac{H_o'}{gT^2} = \frac{11.5}{(32.2)(8.8)^2} = .0046$ $\frac{d_s}{H_o} = \frac{16.1}{11.5} = 1.4$ $\cot\theta = 1.5$

$R/H_o = 2.95$ for $d_s/H_o = 0.8$ (Fig 7-10, SPM)
$R/H_o = 2.62$ for $d_s/H_o = 2.0$ (Fig 7-11, SPM)
$R/H_o = 2.78$ for $d_s/H_o = 1.4$ (Interpolated)

$R = (11.5)(2.78) = 32.0'$ smooth
SCALE CORRECTION FACTOR = 1.206 (Fig 7-13, SPM)

$\left[\frac{R}{H_o}\right]_{riprap} = 1.3$ (Fig 7-15, SPM) $\frac{[R/H_o]_{riprap}}{[R/H_o]_{smooth}} = \frac{1.3}{2.78} = 0.468$

$R_{riprap} = (1.206)(0.468)(32.0) = 18.1'$

This run-up is based on a lakeshore slope of m=1:10. The lakeshore slope at the project site is m=1:100, therefore GODA CURVES were used to correct the riprap runup calculation (ref NCDED-C letter of 22 Aug 78)

$\frac{d_s}{H_o} = 1.4$ $\frac{H_o'}{gT^2} = \frac{11.5}{(5.12)(8.8)^2} = 0.029$

for m = 1:10 $H/H_o' = 1.06$
for m = 1:100 $H/H_o = 0.87$ ratio $= \frac{0.87}{1.06} = 0.82$

ACTUAL RUN-UP = $(0.82)(18.1) = 14.8'$

CREST HEIGHT is found using Cross + Sollitt Method

$H_{bi} = 14.8\left(1.04 - \frac{3.0}{(0.54)(12.3)}\right) = 8.7'$

CREST HEIGHT = 8.7' + 5.3' = 14.0' above LWD in order to meet design criterion of a 3.0' maximum interior wave in the entrance channel.

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|---|---|---|---|
| NAME OF OFFICE NCBED-DC | COMPUTATION CREST-HEIGHT | | |
| SUBJECT Geneva, OH. small boat harbor. | SOURCE DATA Plan-2 | | |
| COMPUTED BY Pope | CHECKED BY 3/79 | APPROVED BY | |

WEST BREAKWATER ~~GENERAL~~ TRUNK SECTION

$d_s = 11.3'$ $H_o = 12.1$ $H_b = 9.6'$ $T_L = 8.0$
Angle class 3 - boating season

$L_o = 5.12(8)^2 = 327.7$ $d_s/L_o = .0345$

$H/H_o' = 1.095$ (Table C-1, SPM) $H_o' = 9.6/1.095 = 8.8'$, $T_o' = 7.6$

$\frac{H_o'}{gT^2} = \frac{8.8}{(32.2)(7.6)^2} = .00473$ $\frac{d_s}{H_o} = \frac{11.3}{8.8} = 1.28$ $\cot\theta = 1.5$

$R/H_o = 2.92$ for $d_s/H_o = 0.8$ (Fig 7-10, SPM)
$R/H_o = 2.60$ for $d_s/H_o = 2.0$ (Fig 7-11, SPM)
$R/H_o = 2.88$ for $d_s/H_o = 1.28$ (Interpolated)

$R = (8.8)(2.88) = 25.3$ smooth

SCALE CORRECTION FACTOR $= 1.206$ (Fig 7-13, SPM)

$\left[\frac{R}{H_o}\right]_{riprap} = 1.3$ (Fig 7-15, SPM) $\frac{[R/H_o]_{riprap}}{[R/H_o]_{smooth}} = \frac{1.30}{2.88} = 0.45$

$R_{riprap} = (1.206)(0.45)(25.3) = 13.7'$

This run-up is based on a lakeshore slope of m = 1:10. The lakeshore slope at the project site is m = 1:100, therefore GODA CURVES were used to correct the riprap runup calculation (ref NCDED-C letter of 22 Aug 78).

$\frac{d_s}{H_o} = 1.28$ $\frac{H_o'}{L_o} = \frac{8.8}{(5.12)(7.6)^2} = 0.030$

for M = 1:10 $H/H_o = 1.075$
for M = 1:100 $H/H_o = 0.8$ ratio $= \frac{0.8}{1.075} = 0.744$

ACTUAL RUN-UP $= (0.744)(13.7) = 10.2'$

CREST HEIGHT is found using Cross and Sollitt Method

$H_{bi} = 10.2'\left(1.04 - \frac{1.0}{(0.54)(9.6)}\right) = 8.6$

CREST HEIGHT $= 8.6 + 5.3' = 13.9'$ above LWD in order to meet design criterion of a 1.0' maximum interior wave in the entrance channel.

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| COMPUTATION SHEET | DATE MARCH 79 | PAGE 9B OF | FILE NUMBER |
|---|---|---|---|
| NAME OF OFFICE NCBED-DC | COMPUTATION Crest Height - | | |
| SUBJECT Geneva, OH. small boat harbor | SOURCE DATA Plan-2 | | |
| COMPUTED BY Pope | CHECKED BY 3/79 | APPROVED BY | |

SAND TRAP BREAKWATER

$d_s = 9.3$ $H_b = 7.9'$ Angle class 3 $T_b = 7.3$

$L_o = 5.12(7.3)^2 = 272.8$ $d_s/L_o = 9.3/272.8 = .0341$

$H/H_o' = 1.098$ $H_o' = 7.9/1.098 = 7.2'$ $T_o' = 7.0$

$\frac{H_o'}{gT^2} = \frac{7.2}{(32.2)(7.0)^2} = .0046$ $\frac{d_s}{H_o'} = \frac{9.3}{7.2} = 1.29$ $\cot\theta = 1.5$

$R/H_o = 2.95$ for $d_s/H_o = 0.8$ (Fig 7-10, SPM)
$R/H_o = 2.62$ for $d_s/H_o = 2.0$ (Fig 7-10, SPM
$R/H_o = 2.82$ for $d_s/H_o = 1.29$ (Interpolated)

$R = (7.2)(2.82) = 20.3$
SCALE CORRECTION FACTOR = 1.206 (Fig 7-13, SPM)

$\left[\frac{R}{H_o}\right]_{riprap} = 1.30$ (Fig 7-15, SPM) $\frac{[R/H_o]_{riprap}}{[R/H_o]_{smooth}} = \frac{1.30}{2.82} = 0.461$

$R_{riprap} = (1.206)(0.461)(20.3) = 11.3$

This run-up is based on a lakeshore slope of m = 1:10. The lakeshore slope at the project site is m = 1:100, therefore GODA CURVES were used to correct the riprap runup calculations (ref NCDED-E letter of 22 Aug 78).

$\frac{d_s}{H_o} = 1.29$ $\frac{H_o'}{L_o} = \frac{7.2}{(5.12)(7.0)^2} = .029$

for M = 1:10 $H/H_o = 1.07$ ratio = $\frac{0.81}{1.07} = 0.757$
for M = 1:100 $H/H_o = 0.81$

ACTUAL RUNUP = (0.757)(11.3) = 8.6'

CREST HEIGHT is found using Cross - Sollitt Method

$H_{bi} = 8.6(1.04 - \frac{3.0}{(0.54)(7.9)}) = 2.9$

CREST HEIGHT = 2.9 + 5.3' = 8.2' above LWD in order to meet design criterion of a sheltered sand trap where no more than a 3.0' maximum wave due to overtopping is experienced

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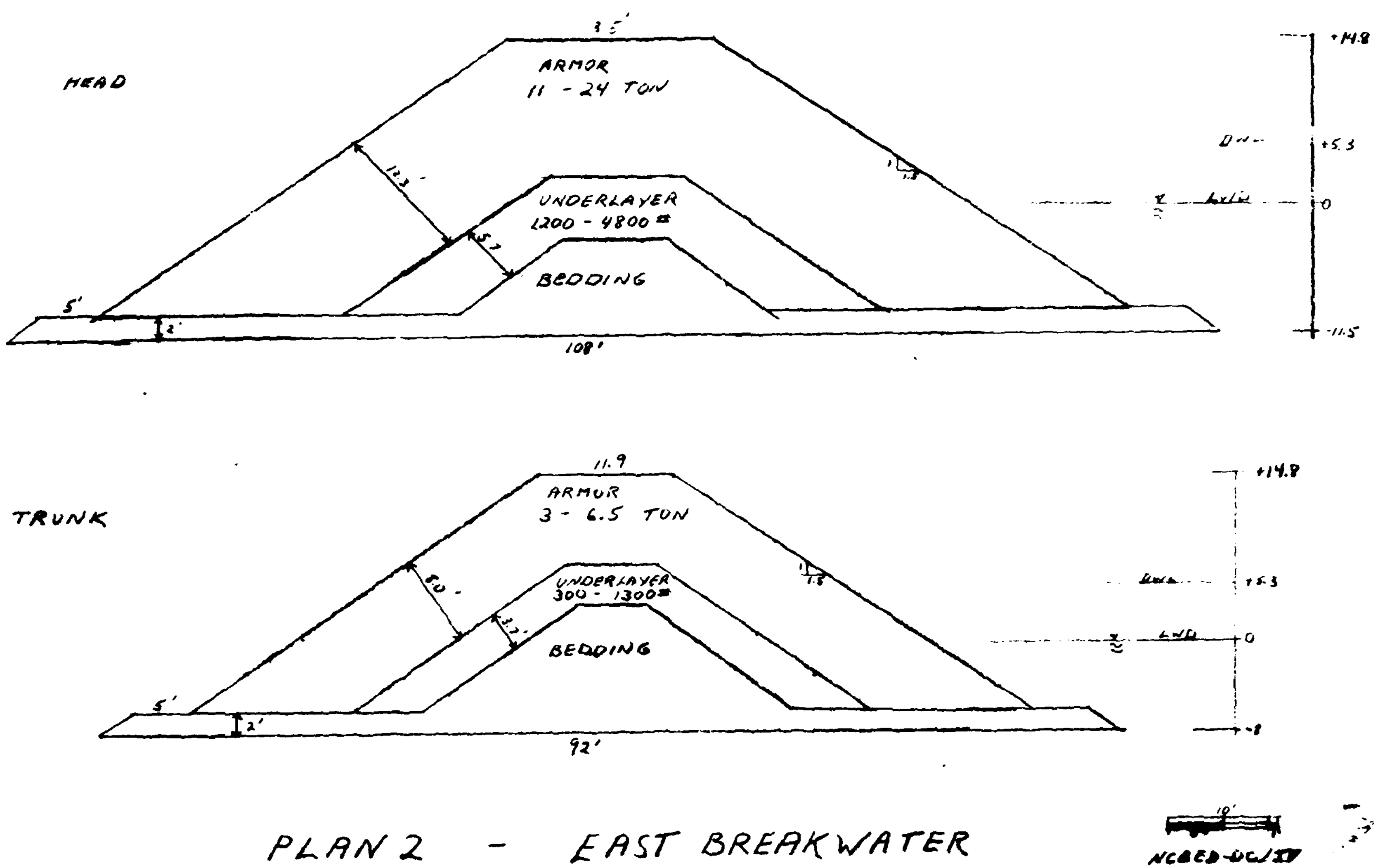
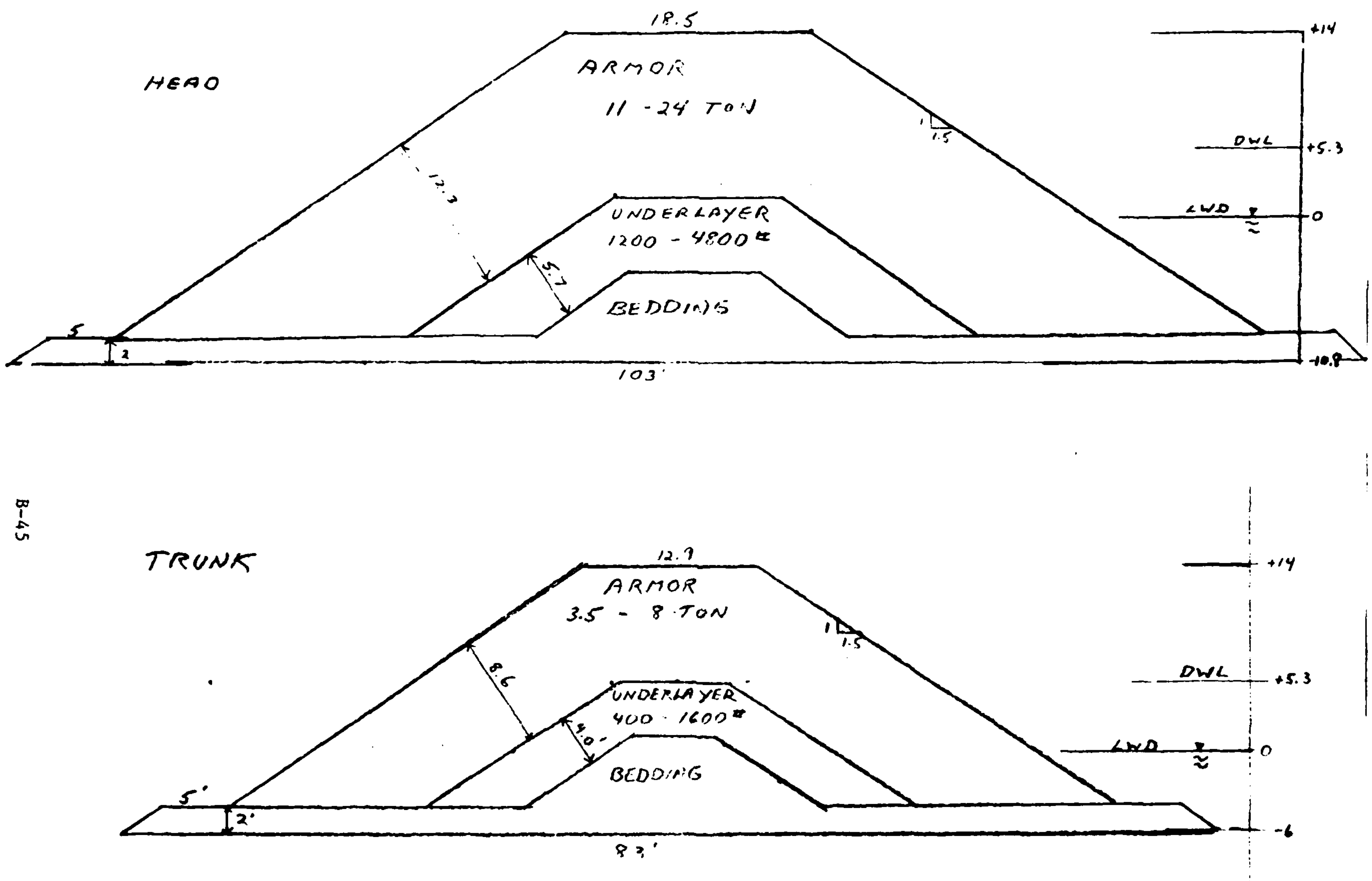


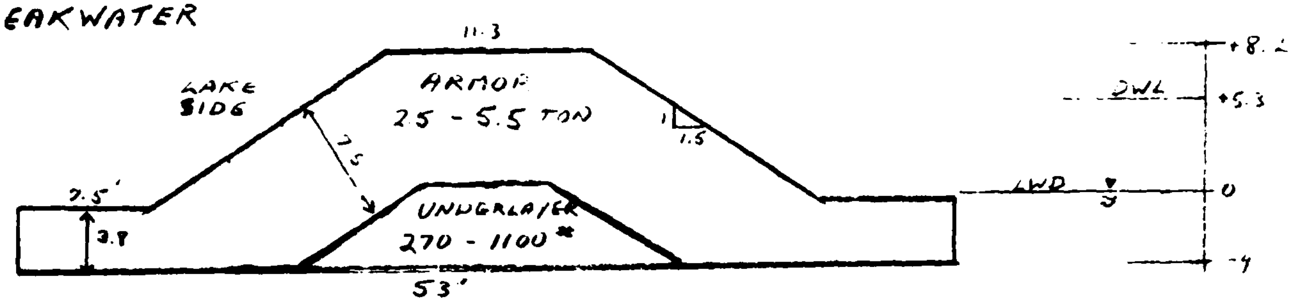

PLAN 2 - EAST BREAKWATER




PLAN 2 - WEST BREAKWATER

NCBED-DC/TP/March 79

SAND TRAP BREAKWATER




PLAN 2

NCBED-DC/JP/MARCH 79

| COMPUTATION SHEET | DATE Feb 79 | PAGE 1C OF | FILE NUMBER |
|---|---|---|---|
| NAME OF OFFICE NCBED-DC | | COMPUTATION Design wave | |
| SUBJECT Geneva, OH. small boat harbor. | | SOURCE DATA Plan-3 | |
| COMPUTED BY JPipe | CHECKED BY @ 3/79 | APPROVED BY | |

B61 PLAN 3 - Design wave for stone size

EAST BREAKWATER HEAD SECTION    sounding = 7.0'

$d_s = 5.3 + 7.0 = 12.3$

$H_o = 13.4'$

use RAY 16 of Refraction Analysis where period = 8.1 sec and Azimuth is 330° (Angle Class 2) and depth = 13.46' (see Plot C)

$K_R = .9271$

$K_s = 1.0640$

$H_i = H_o K_R K_s = 11.8'$

$\frac{d_s}{gT^2} = \frac{12.3}{(32.2)(8.1)^2} = .0058$    $m = 0.01$

$\frac{H_b}{d_s} = 0.85$ (Fig 7-4, SPM)    $H_b = (0.85)(12.3) = 10.5'$

∴ Design wave is 10.5' breaking wave

TRUNK SECTION    sounding = 5.0'

$d_s = 5.3 + 5.0 = 10.3'$

$\frac{d_s}{gT^2} = \frac{10.3}{(32.2)(8.1)^2} = .0049$    $m = 0.01$

$\frac{H_b}{d_s} = .85$ (Fig 7-4, SPM)    $H_b = (0.85)(10.3) = 8.8'$

∴ Design wave is 8.8' breaking wave

WEST BREAKWATER HEAD SECTION    sounding = 11.5'

$d_s = 5.3 + 11.5' = 16.8'$

$H_o = 13.1$

use RAY 23 of Refraction Analysis where period = 9.4 sec and Azimuth is 270° (Angle Class 3) and depth = 16.66' (see PLOT E)

$K_R = 0.9527$

$K_s = 1.0810$

$H_i = H_o K_R K_s = 13.5'$

∴ Design wave is 13.5' non-breaking wave

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|---|---|---|---|
| NAME OF OFFICE NCBED-DC | COMPUTATION Design wave | | |
| SUBJECT Geneva, OH. small boat harbor | SOURCE DATA Plan. 3 | | |
| COMPUTED BY J. Pope | CHECKED BY 3/79 | APPROVED BY | |

TRUNK SECTION                sounding = 8'

$d_s = 5.3 + 8 = 13.3'$

$H_o = 13.1$

Use RAY 24 of Refraction Analysis where period = 9.4 sec and Azimuth is 270° (Angle Class 3) and depth = 14.58' (see PLOT E)

$K_R = 0.9316$

$K_S = 1.1094$

$H_i = H_o K_R K_S = 13.5'$

$\frac{d_s}{gT^2} = \frac{13.3}{(32.2)(9.4)^2} = .0047$        $m = 0.01$

$\frac{H_b}{d_s} = 0.85$ (Fig 7-4, SPM)        $H_b = (0.85)(13.3) = 11.3'$

∴ Design wave is 11.3' breaking wave

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| COMPUTATION SHEET | DATE Feb 79 | PAGE 3C OF | FILE NUMBER |
|---|---|---|---|
| NAME OF OFFICE NCBED-DC | COMPUTATION stone size | | |
| SUBJECT Geneva, OH. small boat harbor | SOURCE DATA Plan 3 | | |
| COMPUTED BY J. Pope | CHECKED BY 3/79 | APPROVED BY | |

# PLAN 3 - STONE SIZES

EAST BREAKWATER HEAD SECTION $\qquad H_i = 10.5$ (breaking)

$$W = \frac{(155)(10.5)^3}{(2.9)(3.242)(1.5)} = 12,723 \text{ lbs}$$

ARMOR STONE

$W_{max} = 2.0W = 25,446$ lbs = (12.72 TONS)

$W_{min} = 0.9W = 11,451$ lbs = (5.73 TONS)

$r = (2)(1.15)\left(\frac{W}{155}\right)^{\frac{1}{3}} = 10.0$

UNDERLAYER STONE

$W_{max} = 0.2W = 2545$ lbs

$W_{min} = 0.05W = 636$ lbs

$r = (2)(1.15)\left(\frac{0.1W}{155}\right)^{\frac{1}{3}} = 4.6'$

BEDDING

$W_{max} = 0.01W = 127$ lbs

$W_{min} = 0.000125W = 1.6$ lbs

CREST WIDTH

$B = (3)(1.15)\left(\frac{W}{155}\right)^{\frac{1}{3}} = 15.0'$

TRUNK SECTION $\qquad H_i = 8.8'$ (breaking)

$$W = \frac{(155)(8.8)^3}{(3.5)(3.242)(1.5)} = 6206. \text{ lbs}$$

ARMOR STONE

$W_{max} = 2.0W = 12412$ lbs = (6.21 TONS)

$W_{min} = 0.9W = 5,585$ lbs = (2.79 TONS)

$r = (2)(1.15)\left(\frac{W}{155}\right)^{\frac{1}{3}} = 7.9'$

UNDERLAYER STONE

$W_{max} = 0.2W = 1241$ lbs

$W_{min} = 0.05W = 310$ lbs

$r = (2)(1.15)\left(\frac{0.1W}{155}\right)^{\frac{1}{3}} = 3.7'$

BEDDING

$W_{max} = 0.01W = 62$ lbs

$W_{min} = 0.000125W = 0.8$ lbs

CREST WIDTH

$B = (3)(1.15)\left(\frac{W}{155}\right)^{\frac{1}{3}} = 11.8'$

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| COMPUTATION SHEET | DATE Feb 79 | PAGE 4C OF | FILE NUMBER |
|---|---|---|---|
| NAME OF OFFICE NCBED-DC | COMPUTATION stone size | | |
| SUBJECT Geneva, OH. small boat harbor | SOURCE DATA Plan - 3 | | |
| COMPUTED BY J. Pope | CHECKED BY 3/79 | APPROVED BY | |

WEST BREAKWATER HEAD SECTION $H_i = 13.5'$ (non-breaking)

$W = \frac{(155)(13.5)^3}{(3.2)(3.242)(1.5)} = 24{,}506$ lbs

ARMOR STONE

$W_{max} = 2.0W = 49{,}013$ lbs $= 24.51$ TONS

$W_{min} = 0.9W = 22{,}056$ lbs $= 11.03$ TONS

$r = (2)(1.15)(\frac{W}{155})^{1/3} = 12.4'$

UNDERLAYER STONE

$W_{max} = 0.2W = 4901$ lbs

$W_{min} = 0.05W = 1225$ lbs

$r = (2)(1.15)(\frac{0.1W}{155})^{1/3} = 5.8'$

BEDDING

$W_{max} = 0.01W = 245$ lbs

$W_{min} = 0.000125W = 3.1$ lbs

CREST WIDTH

$B = (3)(1.15)(\frac{W}{155})^{1/3} = 18.7'$

TRUNK SECTION $H_i = 11.3'$ (breaking)

$W = \frac{(155)(11.3)^3}{(3.5)(3.242)(1.5)} = 13{,}140$ lbs

ARMOR STONE

$W_{max} = 2.0W = 26{,}280$ lbs $=$ (13.14 TONS)

$W_{min} = 0.9W = 11{,}826$ lbs $=$ (5.91 TONS)

$r = (2)(1.15)(\frac{W}{155})^{1/3} = 10.1'$

UNDERLAYER STONE

$W_{max} = 0.2W = 2628$ lbs

$W_{min} = 0.05W = 657$ lbs

$r = (2)(1.15)(\frac{0.1W}{155})^{1/3} = 4.7'$

BEDDING

$W_{max} = 0.01W = 131.4$ lbs

$W_{min} = 0.000125W = 1.6'$

CREST WIDTH

$B = (3)(1.15)(\frac{W}{155})^{1/3} = 15.2'$

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| COMPUTATION SHEET | DATE March 79 | PAGE 5C OF | FILE NUMBER |
|---|---|---|---|

| NAME OF OFFICE NCBED-DC | COMPUTATION CREST HEIGHT. |
|---|---|
| SUBJECT Geneva, OH. small boat harbor | SOURCE DATA Plan-3 |

| COMPUTED BY Pope | CHECKED BY 3/79 | APPROVED BY |
|---|---|---|

EAST BREAKWATER HEAD SECTION

$ds = 12.3$ $\quad H_o = 12.1,\ T_o = 7.8$ Angle class 2 - boating season wave $\quad Hb = 10.5 \quad Tb = 7.3$

$L_0 = 5.12(7.3)^2 = 272.8 \qquad \frac{d_s}{L_0} = \frac{12.3}{272.8} = .0451$

$H/H_o' = 1.042$ (Table C-1, SPM) $\quad H_o' = 10.5/1.042 = 10.1 \quad T_o' = 7.2$

$\frac{H_o'}{gT^2} = \frac{10.1}{(32.2)(7.2)^2} = .0061 \qquad \frac{d_s}{H_o} = \frac{12.3}{10.1} = 1.22 \qquad \cot\theta = 1.5$

$R/H_o = 2.54$ for $d_s/H_o = 0.8$ (Fig 7-10, SPM)
$R/H_o = 2.41$ for $d_s/H_o = 2.0$ (Fig 7-11, SPM)
$R/H_o = 2.50$ for $d_s/H = 1.22$ (Interpolated)

$R = (10.1)(2.5) = 25.25$ smooth

SCALE CORRECTION FACTOR = 1.206 (Fig 7-13, SPM)

$\left[\frac{R}{H_o}\right]_{riprap} = 1.2$ (Fig 7-15, SPM) $\qquad \frac{[R/H_o]_{riprap}}{[R/H_o]_{smooth}} = \frac{1.2}{2.5} = 0.48$

$R_{riprap} = (1.206)(0.48)(25.3) = 14.6'$

This run-up is based on a lakeshore slope of m = 1:10. The lakeshore slope at the project site is m = 1:100, therefore GODA CURVES were used to correct the riprap runup calculation (ref NCDED-C letter of 22 Aug 1978).

$\frac{d_s}{H_o} = 1.22 \qquad \frac{H_o'}{L_0} = \frac{10.1}{(5.12)(7.2)^2} = .0381$

for $m = 1:10$ $\quad H/H_o' = 1.03$
for $m = 1:100$ $\quad H/H_o = 0.76$ $\qquad$ ratio $= \frac{0.76}{1.03} = 0.74$

ACTUAL RUN-UP = (0.74)(14.6) = 10.8

CREST HEIGHT is found using Cross and Sollitt Method

$$H_{bi} = 10.8\left(1.04 - \frac{3.0}{(0.54)(10.5)}\right) = 5.5$$

CREST HEIGHT = 5.5 + 5.3 = 10.8' above LWD in order to meet design criterion of a 3.0' maximum interior wave in the entrance channel.

| COMPUTATION SHEET | DATE March 79 | PAGE 6C OF | FILE NUMBER |
|---|---|---|---|
| NAME OF OFFICE NCBED-DC | | COMPUTATION CREST HEIGHT | |
| SUBJECT Geneva OH. Small boat harbor. | | SOURCE DATA Plan. 3 | |
| COMPUTED BY Pope | CHECKED BY 3/79 | | APPROVED BY |

EAST BREAKWATER TRUNK SECTION

$d_s = 10.3$ $\qquad H_b = 8.8'$ $\quad T_b = 6.8$ sec

$L_o = 5.12(6.8)^2 = 236.7$ $\qquad \frac{d_s}{L_o} = .0435$

$H/H_o' = 1.048$ (Table C-1, SPM)

$H_o' = 8.8/1.048 = 8.4'$ $\qquad T_o = 6.7$ sec

$\frac{H_o'}{gT^2} = \frac{8.4}{(32.2)(6.7)^2} = .0058$ $\qquad \frac{d_s}{H_o'} = \frac{10.3}{8.4} = 1.23$ $\qquad \cot\theta = 1.5$

$R/H_o = 2.7$ for $d_s/H_o' = 0.8$ (Fig 7-10, SPM)

$R/H_o = 2.5$ for $d_s/H_o' = 2.0$ (Fig 7-11, SPM)

$R/H_o = 2.62$ for $d_s/H_o' = 1.23$ (Interpolated)

$R = (8.4)(2.62) = 22.0'$

SCALE CORRECTION FACTOR = 1.206 (Fig 7-13, SPM)

$\left[\frac{R}{H_o}\right]_{riprap} = 1.20$ (Fig 7-15, SPM) $\qquad \frac{[R/H_o']_{riprap}}{[R/H_o]_{smooth}} = \frac{1.20}{2.62} = .458$

$R_{riprap} = (1.206)(0.458)(22.0) = 12.2$

This run-up is based on a lakeshore slope of m = 1:10. The lakeshore slope at the project site is m = 1:100, therefore GODA CURVES were used to correct the riprap runup calculation (ref NCDED-C letter of 22 AUG 1978).

$\frac{d_s}{H_o} = 1.23$ $\qquad \frac{H_o'}{L_o} = \frac{8.4}{5.12(6.7)^2} = .0365$

for m = 1:10 $\quad H/H_o' = 1.05$

for m = 1:100 $\quad H/H_o = 0.765$ $\qquad$ ratio $= \frac{0.765}{1.05} = .73$

ACTUAL RUN-UP = (0.73)(12.2) = 8.9'

CREST HEIGHT is found using Cross + Sollitt method

$H_{b_1} = 8.9\left(1.04 - \frac{3.0}{(0.54)(8.8)}\right) = 3.6'$

CREST HEIGHT = 3.6 + 5.3 = 8.9' above LWD in order to meet design criterion of a 3.0' maximum interior wave in entrance channel.

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| COMPUTATION SHEET | DATE March 79 | PAGE 7C OF | FILE NUMBER |
|---|---|---|---|
| NAME OF OFFICE NCBED-DC | COMPUTATION CREST HEIGHT | | |
| SUBJECT Geneva, OH. small boat harbor. | SOURCE DATA Plan. 3 | | |
| COMPUTED BY Pope | CHECKED BY [illegible] 3/79 | APPROVED BY | |

WEST BREAKWATER HEAD SECTION

$ds = 16.8'$ $H_o = 12.'$ (Angle class 3 boating season) $T_o = 9$ sec

use RAY 23 of Refraction Analysis where period = 9.0 sec and Azimuth is 270° (Angle class 3) and depth = 17.01 (See PLOT D)

$K_R = 0.9543$ $K_s = 1.0593$ $H_i = H_o K_R K_s = 12.23$

$H_o' = K_R H_o = 11.5'$ $T_o' = 8.8$ sec [illegible] period.

$\frac{H_o'}{gT^2} = \frac{11.5}{(32.2)(8.8)^2} = .0046$ $\frac{ds}{H_o'} = \frac{16.8}{11.5} = 1.46$ $\cot\theta = 1.5$

$R/H_o = 2.90$ for $ds/H = 0.8$ (Fig 7-10, SPM)

$R/H_o = 2.60$ for $ds/H = 2.0$ (Fig 7-11, SPM)

$R/H_o = 2.72$ for $ds/H = 1.46$ (Interpolated)

$R = (11.5)(2.72) = 31.3$

SCALE CORRECTION FACTOR = 1.206 (Fig 7-13, SPM)

$\left[\frac{R}{H_o}\right]_{riprap} = 1.2$ (Fig 7-15, SPM) $\frac{[R/H_o]_{riprap}}{[R/H_o]_{smooth}} = \frac{1.2}{2.72} = 0.44$

$R_{riprap} = (31.3)(1.206)(.44) = 16.6$

This run-up is based on a lakeshore slope of m = 1:10. The lakeshore slope at the project site is m = 1:100, therefore GODA curves were used to correct the riprap run-up calculation (ref NCDED-C letter of 22 AUG 1978).

$\frac{ds}{H_b} = 1.46$ $\frac{H_o'}{L_o} = \frac{11.5}{(5.12)(8.8)^2} = .028$

for M = 1:10 $H/H_o' = 1.06$

for M = 1:100 $H/H_o' = .89$ ratio = $\frac{0.89}{1.06} = 0.84$

ACTUAL RUN-UP = (0.84)(16.6) = 13.9'

CREST HEIGHT is found using Cross + Sollitt Method

$H_{bi} = 13.9\left(1.04 - \frac{3.0}{(0.54)(12.2)}\right) = 8.1'$

CREST HEIGHT = 8.1 + 5.3 = 13.4' above LWD in order to meet design criterion of a 3.0' maximum interior wave in entrance channel.

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|---|---|---|---|
| NAME OF OFFICE NCBED-DC | | COMPUTATION CREST HEIGHT | |
| SUBJECT GENEVA, OH. small boat harbor. | | SOURCE DATA Plan.3 | |
| COMPUTED BY Pope | CHECKED BY 3/79 | APPROVED BY | |

WEST BREAKWATER ~~TRUNK~~ SECTION

$d_s = 13.3$   $H_o = 12.1$   $T_o = 9$ sec   $H_b = 11.3$   $T_b = 8.7$ sec.

Angle class 3 - boating season

$L_o = 5.12(8.7)^2 = 387.5$   $\frac{d_s}{L_o} = .034$

$H/H_o' = 1.098$ (Table C-1, SPM)   $H_o' = 10.3$   $T_o' = 8.3$

$\frac{H_o'}{gT^2} = \frac{10.3}{(32.2)(8.3)^2} = .00464$   $\frac{d_s}{H_o} = \frac{13.3}{10.3} = 1.29$

$R/H_o = 2.90$ for $d_s/H = 0.8$ (Fig 7-10, SPM)
$R/H_o = 2.60$ for $d_s/H = 2.0$ (Fig 7-11, SPM)
$R/H_o = 2.78$ for $d_s/H = 1.29$ (Interpolated)

$R = (10.3)(2.78) = 28.6$

SCALE CORRECTION FACTOR = 1.206 (Fig 7-13, SPM)

$\left[\frac{R}{H_o}\right]_{riprap} = 1.25$ (Fig 7-15, SPM)   $\frac{[R/H_o]_{riprap}}{[R/H_o]_{smooth}} = \frac{1.25}{2.78} = 0.45$

$R_{riprap} = (1.206)(0.45)(28.6) = 15.5'$

This run-up is based on a lakeshore slope of m=1:10. The lakeshore slope at the project site is m=1:100, therefore GODA CURVES were used to correct the riprap run-up calculation (ref NCDED-C letter of 22 AUG 1978).

$\frac{d_s}{H_o} = 1.29$   $\frac{H_o'}{L_o} = \frac{10.3}{(5.12)(8.3)^2} = .0292$

for $m = 1:10$   $H/H_o = 1.08$
for $m = 1:100$   $H/H_o = 0.81$   ratio $= \frac{0.81}{1.08} = 0.75$

ACTUAL RUN-UP = $(0.75)(15.5) = 11.6'$

CREST HEIGHT is found using Cross + Sollitt Method

$$H_{bi} = 11.6\left(1.04 - \frac{30}{(0.54)(11.3)}\right) = 6.4'$$

CREST HEIGHT = $6.4 + 5.3 = 11.7'$ above LWD in order to meet design criterion of a 3.0' maximum interior wave in the entrance channel.

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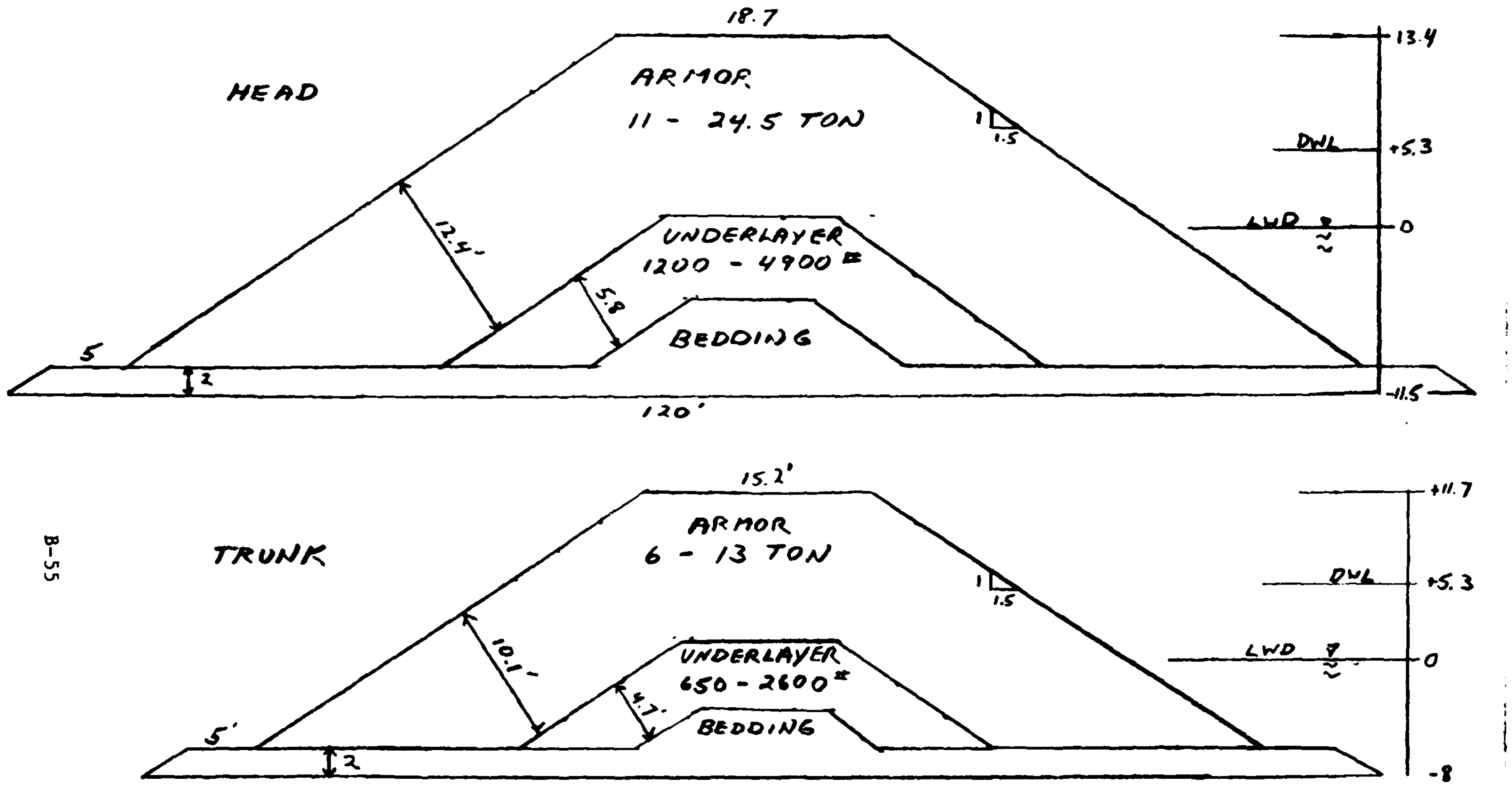
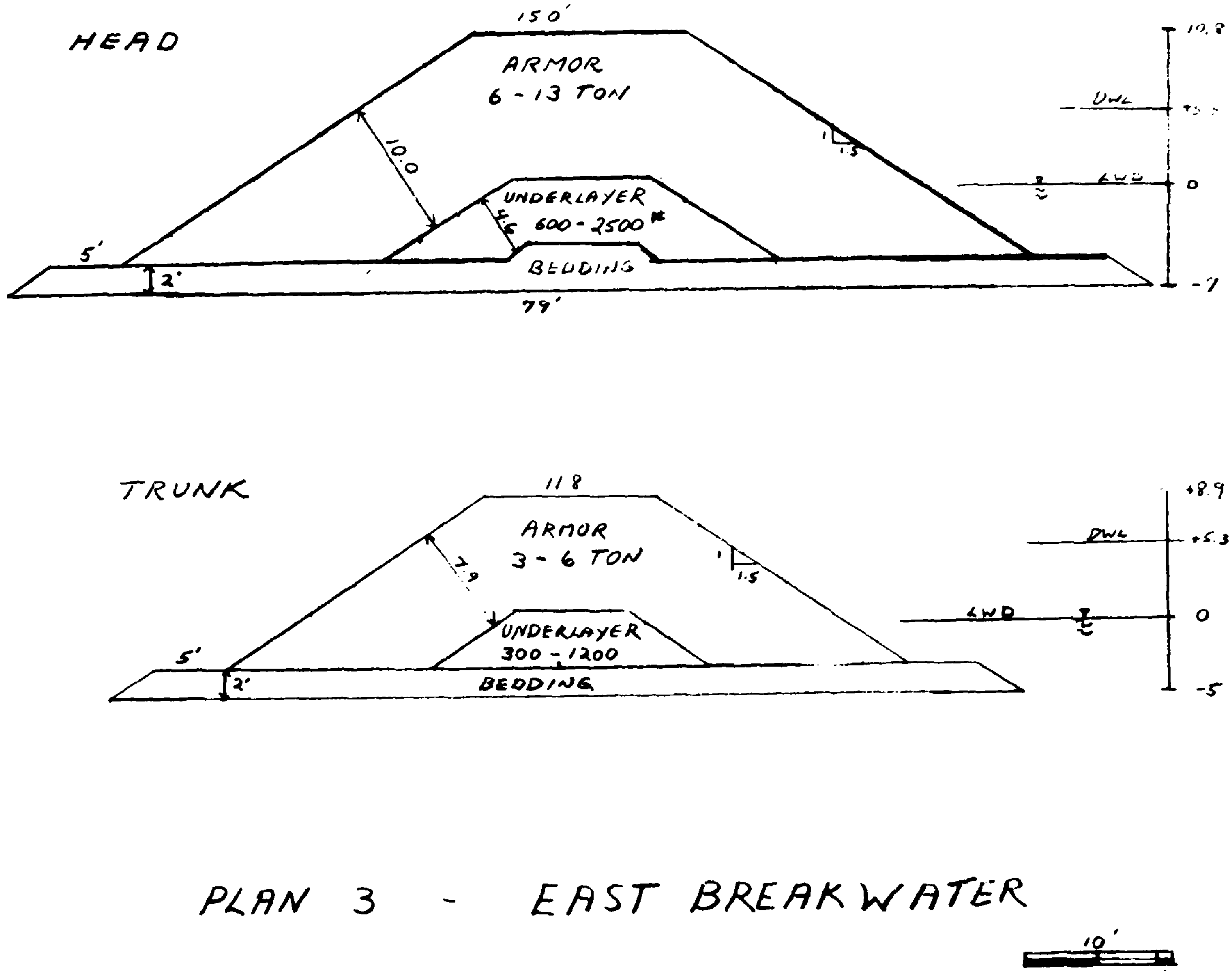



PLAN 3 - WEST BREAKWATER

NCBED-DC/JP/MARCH79




PLAN 3 - EAST BREAKWATER

| COMPUTATION SHEET | DATE Feb 79 | PAGE 10 OF | FILE NUMBER |
|---|---|---|---|

| NAME OF OFFICE NCBED-DC | COMPUTATION Design wave. |
|---|---|
| SUBJECT Geneva, OH. small boat harbor. | SOURCE DATA Plan. 4 |

| COMPUTED BY J. Pope | CHECKED BY [initials] 3/79 | APPROVED BY |
|---|---|---|

B62 PLAN 4 - Design wave for stone size

EAST BREAKWATER HEAD SECTION　　　sounding = 8'

$ds = 5.3 + 8 = 13.3$　　　$H_o = 13.1$ ; ANGLE CLASS 3 ; $T = 9.4$

$\frac{ds}{gT^2} = \frac{13.3}{(32.2)(9.4)^2} = .0047$　　　$m = 0.01$

$\frac{Hb}{ds} = 0.85$ (Fig 7-4, SPM)　　　$Hb = (13.3)(0.85) = 11.3'$

∴ Design wave is 11.3' breaking wave

TRUNK SECTION　　　sounding = 6'

$ds = 5.3 + 6 = 11.3'$　　　$H_o = 13.4$, $T = 8.1$ ; ANGLE CLASS 2

$\frac{ds}{gT^2} = \frac{11.3}{(32.2)(8.1)^2} = .0053$　　　$m = 0.01$

$\frac{Hb}{ds} = 0.85$ (Fig 7-4, SPM)　　　$Hb = (0.85)(11.3) = 9.6'$

∴ Design wave is 9.6' breaking wave

WEST BREAKWATER HEAD SECTION　　　sounding = 10'

$ds = 5.3 + 10 = 15.3$

$Ho = 13.1$

use RAY 24 of REFRACTION ANALYSIS where period = 9.4 sec and Azimuth is 270° (Angle Class 3) and depth (see PLOT E) = 16.08

$K_R = 0.9447$

$K_S = 1.0884$

$H_i = H_o K_R K_S = 13.5$

$\frac{ds}{gT^2} = \frac{15.3}{(32.2)(9.4)^2} = .0054$　　　$m = 0.01$

$\frac{Hb}{ds} = 0.85$ (Fig 7-4, SPM)　　　$Hb = (0.85)(15.3) = 13.0'$

∴ Design wave is 13.0' breaking wave

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| COMPUTATION SHEET | DATE Feb 79 | PAGE 2D OF | FILE NUMBER |
|---|---|---|---|
| NAME OF OFFICE NCBED-DC | COMPUTATION Design wave | | |
| SUBJECT Geneva, OH. small boat harbor. | SOURCE DATA Plan-4 | | |
| COMPUTED BY J Pope | CHECKED BY 3/79 | APPROVED BY | |

TRUNK SECTION

sounding = 8'

$d_s = 5.3 + 8 = 13.3'$

$H_o = 13.1$, $T = 9.4$ Angle class 3

$\frac{d_s}{gT^2} = \frac{13.3}{(32.2)(9.4)^2} = .0047$

$m = 0.01$

$\frac{H_b}{d_s} = 0.85$ (Fig 7-4, SPM)

$H_b = (.85)(13.3) = 11.3'$

∴ Design wave is 11.3' breaking wave.

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| COMPUTATION SHEET | DATE Feb 79 | PAGE 3D OF | FILE NUMBER |
|---|---|---|---|
| NAME OF OFFICE NCBED-DC | COMPUTATION stone size | | |
| SUBJECT Geneva, OH. small boat harbor. | SOURCE DATA Plan-4 | | |
| COMPUTED BY J Pope | CHECKED BY 3/79 | APPROVED BY | |

# PLAN 4 - STONE SIZES

## EAST BREAKWATER HEAD SECTION

$H_i = 11.3$ (breaking)

$$W = \frac{(155)(11.3)^3}{(2.9)(3.242)(1.5)} = 15{,}859 \text{ lbs}$$

ARMOR STONE

$W_{max} = 2.0W = 31{,}717$ lbs $= (15.86$ TONS$)$

$W_{min} = 0.9W = 14{,}273$ lbs $= (7.14$ TONS$)$

$r = (2)(1.15)\left(\frac{W}{155}\right)^{1/3} = 10.8'$

UNDERLAYER STONE

$W_{max} = 0.2W = 3171$ lbs

$W_{min} = 0.05W = 793$ lbs

$r = (2)(1.15)\left(\frac{0.1W}{155}\right)^{1/3} = 5.0'$

BEDDING

$W_{max} = 0.01W = 158.6$ lbs

$W_{min} = 0.000125W = 2.0$ lbs

CREST WIDTH

$B = (3)(1.15)\left(\frac{W}{155}\right)^{1/3} = 16.1$

## TRUNK SECTION

$H_i = 9.6$ (breaking)

$$W = \frac{(155)(9.6)^3}{(3.5)(3.242)(1.5)} = 8{,}057 \text{ lbs}$$

ARMOR STONE

$W_{max} = 2.0W = 16{,}114$ lbs $= (8.06$ TONS$)$

$W_{min} = 0.9W = 7251$ lbs $= (3.63$ TONS$)$

$r = (2)(1.15)\left(\frac{W}{155}\right)^{1/3} = 8.6'$

UNDERLAYER STONE

$W_{max} = 0.2W = 1611.6$ lbs

$W_{min} = 0.05W = 403$ lbs

$r = (2)(1.15)\left(\frac{0.1W}{155}\right)^{1/3} = 4.0'$

BEDDING

$W_{max} = 0.01W = 80.6$ lbs

$W_{min} = 0.000125W = 1$ lb

CREST WIDTH

$B = (3)(1.15)\left(\frac{W}{155}\right)^{1/3} = 12.9'$

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|---|---|---|---|

| NAME OF OFFICE NCBED-DC | COMPUTATION stone size |
|---|---|
| SUBJECT Geneva, OH. small boat harbor | SOURCE DATA Plan-4 |

| COMPUTED BY J Pope | CHECKED BY 3/79 | APPROVED BY |
|---|---|---|

WEST BREAKWATER
HEAD SECTION $H_i = 13.0'$ (breaking)

$W = \frac{(155)(13.0)^3}{(2.9)(3.242)(1.5)} = 24,147$ lbs

ARMOR STONE

$W_{max} = 2.0W = 48,294$ lbs $= (24.15$ TONS$)$

$W_{min} = 0.9W = 21,732$ lbs $= (10.87$ TONS$)$

$r = (2)(1.15)\left(\frac{W}{155}\right)^{1/3} = 12.4'$

UNDERLAYER STONE

$W_{max} = 0.2W = 4829$ lbs

$W_{min} = 0.05W = 1207$ lbs

$r = (2)(1.15)\left(\frac{0.1W}{155}\right)^{1/3} = 5.7'$

BEDDING

$W_{max} = 0.01W = 241.5$ lbs

$W_{min} = 0.000125W = 3$ lbs

CREST WIDTH

$B = (3)(1.15)\left(\frac{W}{155}\right)^{1/3} = 18.6'$

TRUNK SECTION $H_i = 11.3$ (breaking)

$W = \frac{(155)(11.3)^3}{(3.5)(3.242)(1.5)} = 13,140$ lbs

ARMOR STONE

$W_{max} = 2.0W = 26,280$ lbs $= (13.14$ TONS$)$

$W_{min} = 0.9W = 11,826$ lbs $= (5.91$ TONS$)$

$r = (2)(1.15)\left(\frac{W}{155}\right)^{1/3} = 10.1'$

UNDERLAYER STONE

$W_{max} = 0.2W = 2628$ lbs

$W_{min} = 0.05W = 657$ lbs

$r = (2)(1.15)\left(\frac{0.1W}{155}\right)^{1/3} = 4.7'$

BEDDING

$W_{max} = 0.01W = 131.4$ lbs

$W_{min} = 0.000125W = 1.6$ lbs

CREST WIDTH

$B = (3)(1.15)\left(\frac{W}{155}\right)^{1/3} = 15.2'$

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| COMPUTATION SHEET | DATE MARCH 79 | PAGE 5D OF | FILE NUMBER |
|---|---|---|---|
| NAME OF OFFICE NCBED-DC | | COMPUTATION CREST HEIGH. | |
| SUBJECT Geneva, OH. small boat harbor. | | SOURCE DATA Plan-4 | |
| COMPUTED BY Pope | CHECKED BY 3/79 | APPROVED BY | |

EAST BREAKWATER HEAD SECTION

ds = 13.3 Hb = 11.3 angle class 3 Tb = 8.7

$L_o = (5.12)(8.7)^2 = 387.5$ $\frac{ds}{L_o} = \frac{13.3}{387.5} = .0343$ use 8'

$H/H_o' = 1.096$ (Table C-1, SPM) $H_o' = 11.3/1.096 = 10.3'$ $T_o' = 8.3$

$\frac{H_o'}{gT^2} = \frac{10.3}{(32.2)(8.3)^2} = .00464$ (.0042) $\frac{ds}{H_o} = \frac{13.3}{10.3} = 1.29$ $\cot\theta = 1.5$

$R/H_o = 2.90$ for ds/H = 0.8 (Fig 7-10, SPM)

$R/H_o = 2.60$ for ds/H = 2.0 (Fig 7-11, SPM)

$R/H_o = 2.78$ (2.88) for ds/H = 1.29 (Interpolated)

$R = (10.3)(2.78) = 28.6'$ (2.88) (29.7)

SCALE CORRECTION FACTOR = 1.206 (Fig 7-13, SPM)

$[\frac{R}{H_o}]_{riprap} = 1.25$ (Fig 7-15, SPM) $\frac{[R/H_o]\ riprap}{[R/H_o]\ smooth} = \frac{1.25}{2.78} = 0.45$ (0.434)

$R_{riprap} = (1.206)(.45)(28.6) = 15.5'$ (.434) (29.7)

This run-up is based on a lakeshore slope of m = 1:10. The lakeshore slope at the project site is m = 1:100, therefore GODA CURVES were used to correct the riprap run-up calculation (ref NCDED-DC letter of 22 AUG 1978).

$\frac{ds}{H_o} = 1.29$ $\frac{H_b}{L_o} = \frac{10.3}{(5.12)(8.3)^2} = 0.0292$ (0.0266) (8.7)

for M = 1:10 H/Ho = 1.08

for M = 1:100 H/Ho = 0.81 ratio = $\frac{0.81}{1.08} = 0.75$

ACTUAL RUN-UP = (0.75)(15.5) = 11.6'

CREST HEIGHT is found using Cross + Sollitt Method

$H_{bi} = 11.6\ (1.04 - \frac{3.0}{(0.54)(11.3)}) = 6.4'$

CREST HEIGHT = 6.4 + 5.3 = 11.7' above LWD in order to meet design criterion of a 3.0' maximum interior wave in the Entrance channel.

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| COMPUTATION SHEET | DATE MARCH 79 | PAGE 6D OF | FILE NUMBER |
|---|---|---|---|
| NAME OF OFFICE NCBED-DC | COMPUTATION CREST HEIGHT. | | |
| SUBJECT Geneva, OH. small boat harbor | SOURCE DATA Plan-4 | | |
| COMPUTED BY Pope | CHECKED BY 3/79 | APPROVED BY | |

EAST BREAKWATER TRUNK SECTION

$d_s = 11.3'$ $H_b = 9.6$ $T_b = 7.1$
Angle class 2

$L_o = (5.12)(7.1)^2 = 258.1$ $\frac{d_s}{L_o} = \frac{11.3}{258.1} = 0.0438$

$H/H_o' = 1.047$ $H_o' = 9.6/1.047 = 9.2'$ $T_o' = 7.0$

$\frac{H_o'}{gT^2} = \frac{9.2}{(32.2)(7.0)^2} = .0058$ $\frac{d_s}{H_o'} = \frac{11.3}{9.2} = 1.23$ $\cot\theta = 1.5$

$R/H_o' = 2.60$ for $d_s/H_o' = 0.8$ (Fig 7-10, SPM)
$R/H_o' = 2.45$ for $d_s/H_o' = 2.0$ (Fig 7-11, SPM)
$R/H_o' = 2.55$ for $d_s/H_o' = 1.23$ (Interpolated)

$R = (9.2')(2.55) = 23.46$

SCALE CORRECTION FACTOR = 1.206 (Fig 7-13, SPM)

$\left[\frac{R}{H_o}\right]_{riprap} = 1.15$ (Fig 7-15, SPM) $\frac{[R/H_o]_{riprap}}{[R/H_o]_{smooth}} = \frac{1.15}{2.55} = .45$

$R_{riprap} = (23.46)(1.206)(.45) = 12.7'$

This run-up is based on a lakeshore slope of m = 1:10. The lakeshore slope at the project site is m = 1:100, therefore GODA CURVES were used to correct the riprap run-up calculation (ref NCDED-DC letter of 22 AUG 1978).

$\frac{d_s}{H_b} = 1.23$ $\frac{H_o'}{L_o} = \frac{9.2}{(5.12)(7.0)^2} = .037$

for m = 1:10 $H/H_o' = 1.04$
for m = 1:100 $H/H_o' = 0.79$ ratio $= \frac{0.79}{1.04} = 0.759$

ACTUAL RUN-UP = $(0.759)(12.7) = 9.6'$

CREST HEIGHT is found using Cross + Sollitt Method

$$H_{bi} = 9.6\left(1.04 - \frac{3.0}{(0.54)(9.6)}\right) = 4.4'$$

CREST HEIGHT = $5.3 + 4.4 = 9.7'$ above LWD in order to meet design criterion of a 3.0' maximum interior wave in the entrance channel.

NCD Form 14 1 Apr 6? Previous edition may be used until supply is exhausted.

| COMPUTATION SHEET | DATE MARCH 79 | PAGE 7D OF | FILE NUMBER |
|---|---|---|---|
| NAME OF OFFICE NCBED-DC | COMPUTATION CREST HEIGHT PLAN 4 | | |
| SUBJECT GENEVA, OH. small boat harbor | SOURCE DATA Plan-4 | | |
| COMPUTED BY Pope | CHECKED BY 3/79 | APPROVED BY | |

WEST BREAKWATER HEAD SECTION

$ds = 15.3$    $Ho = 12.1$    $To: 9.0$    (boating season)

use Ray 24 of REFRACTION ANALYSIS where period = 9.0 sec and Azimuth is 270° (Angle Class 3) and depth = 16.42 (see PLOT D)

$K_R = 0.9477$    $K_S = 1.0663$

$Hi = Ho K_R K_S = 12.2$    $H_o' = K_R H_o = 11.5$    $T_o' = 8.8$ max design wave period

$\frac{H_o'}{gT^2} = \frac{11.5}{(32.2)(8.8)^2} = .0046$ (.0044, (9.0)$^2$)    $\frac{ds}{H_o'} = \frac{15.3}{11.5} = 1.33$    $\cot\theta = 1.5$

$R/H_o' = 2.90$ (3.1) for $ds/H_o' = 0.8$ (Fig 7-10, SPM)

$R/H_o' = 2.60$ (2.85) for $ds/H_o' = 2.0$ (Fig 7-11, SPM)

$R/H_o' = 2.77$ for $ds/H_o' = 1.33$ (Interpolated)

$R = (11.5)(2.77) = 31.9$ (33.4)

SCALE CORRECTION FACTOR = 1.206 (Fig 7-13, SPM)

$\left[\frac{R}{H_o}\right]_{riprap} = 1.25$ (Fig 7-15, SPM)    $\frac{[R/H_o]_{riprap}}{[R/H_o]_{smooth}} = \frac{1.25}{2.77} = .45$ (.43)

$R_{riprap} = (1.206)(.45)(31.9) = 17.3$ (.43, 33.4)

This run-up is based on a lakeshore slope of $m = 1:10$. The lakeshore slope at the project site is $m = 1:100$, therefore GODA CURVES were used to correct the riprap run-up calculation (ref NCDED-DC letter of 22 AUG 1978).

$\frac{ds}{H_o} = 1.33$    $\frac{H_o'}{L_o} = \frac{11.5}{(5.12)(8.8)^2} = .029$ (.028, (9.0)$^2$)

for $m = 1:10$    $H/H_o = 1.07$

for $m = 1:100$    $H/H_o = .825$    ratio $= \frac{.825}{1.07} = 0.77$

ACTUAL RUN-UP $= (0.77)(17.3) = 13.3$

CREST HEIGHT is found using Cross & Sollitt Method

$$Hbi = 13.3\left(1.04 - \frac{3.8}{(0.54)(12.2)}\right) = 7.8$$

CREST HEIGHT $= 7.8 + 5.3 = 13.1'$ above LWD in order to meet design criterion of a 3.0' maximum interior wave in the entrance channel.

| COMPUTATION SHEET | DATE MARCH 79 | PAGE 8D OF | FILE NUMBER |
|---|---|---|---|
| NAME OF OFFICE NCDED-DC | COMPUTATION CREST HEIGHT. | | |
| SUBJECT GENEVA, OH. small boat harbor | SOURCE DATA Plan-4 | | |
| COMPUTED BY POPE | CHECKED BY 3/79 | APPROVED BY | |

WEST BREAKWATER
TRUNK SECTION

$ds = 13.3'$ $\quad Hb = 11.3' \quad Tb = 8.7$ (Angle Class 3 - Boating season)

$Lo = 5.12\,(8.7)^2 = 387.5$ $\qquad \frac{ds}{Lo} = .0343$

$H/H_o' = 1.096$ (Table C-1, SPM) $\qquad H_o' = 11.3/1.096 = 10.3'$ $\quad T_o' = 8.3$

$\frac{H_o}{gT^2} = \frac{10.3}{(32.2)(8.3)^2} = .00464$ $\qquad \frac{ds}{H_o} = \frac{13.3}{10.3} = 1.29$ $\qquad \cot\theta = 1.5$

$R/H_o = 2.90$ for $ds/H = 0.8$ (Fig 7-10, SPM)
$R/H_o = 2.60$ for $ds/H = 2.0$ (Fig 7-11, SPM)
$R/H_o = 2.78$ for $ds/H = 1.29$ (Interpolated)

$R = (10.3)\,(2.78) = 28.6'$

SCALE CORRECTION FACTOR = 1.206 (Fig 7-13, SPM)

$\left[\frac{R}{H_o}\right]_{riprap} = 1.25$ (Fig 7-15, SPM) $\qquad \frac{[R/H_o]_{riprap}}{[R/H_o]_{smooth}} = \frac{1.25}{2.78} = 0.45$

$R_{riprap} = (1.206)(.45)(28.6) = 15.5'$

This run-up is based on a lakeshore slope of m=1:10. The lakeshore slope at the project site is m=1:100, therefore GODA CURVES were used to correct the riprap run-up calculation (ref NCDED-DC letter of 22 AUG 1978).

$\frac{ds}{H_o} = 1.29$ $\qquad \frac{H_o'}{L_o} = \frac{10.3}{(5.12)(8.3)^2} = 0.0292$

for $m = 1:10$ $\qquad H/H_o = 1.08$
for $m = 1:100$ $\qquad H/H_o = 0.81$ $\qquad$ ratio $= \frac{0.81}{1.08} = 0.75$

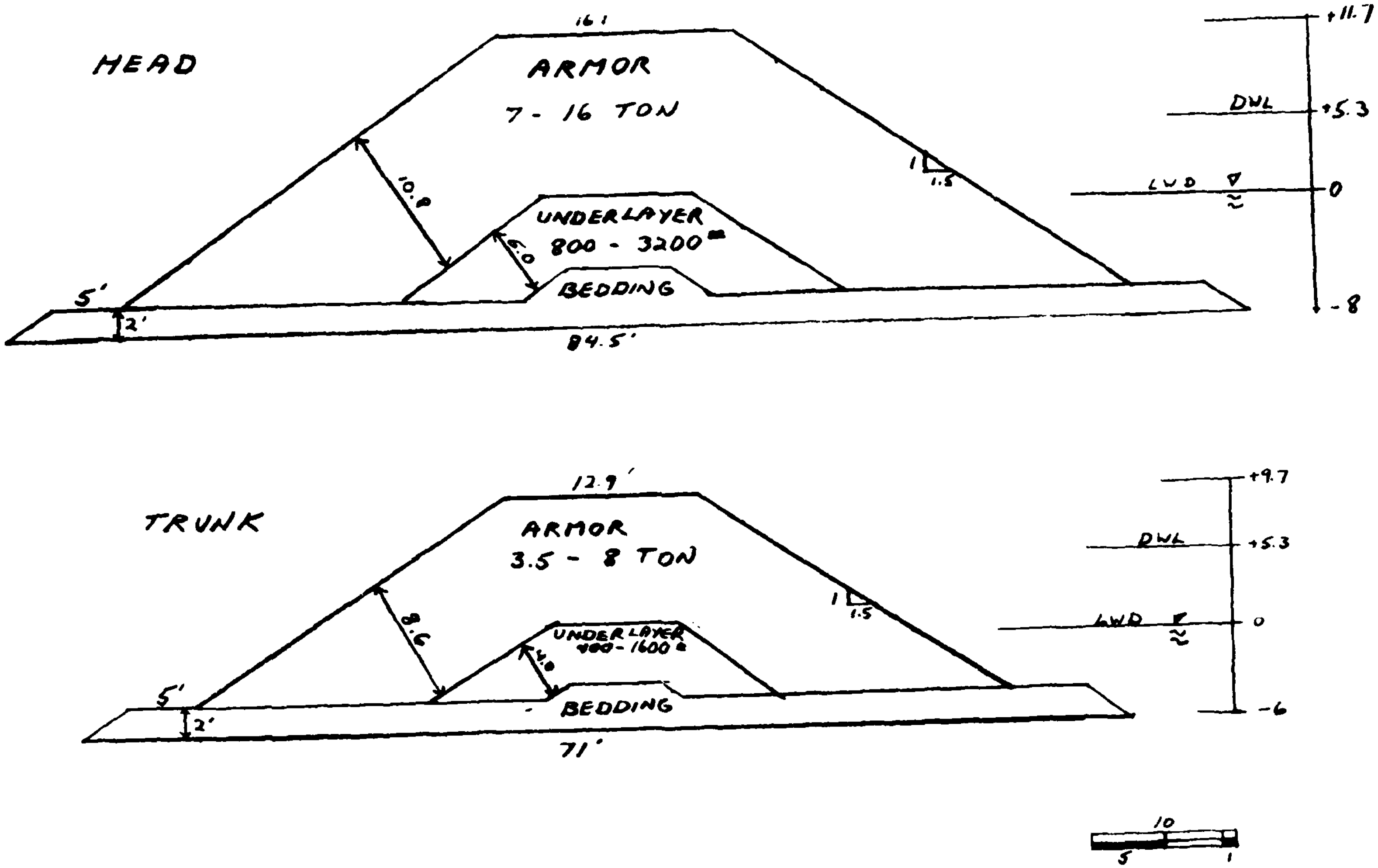
ACTUAL RUN-UP $= (0.75)(15.5) = 11.6'$

CREST HEIGHT is found using Cross + Sollitt Method

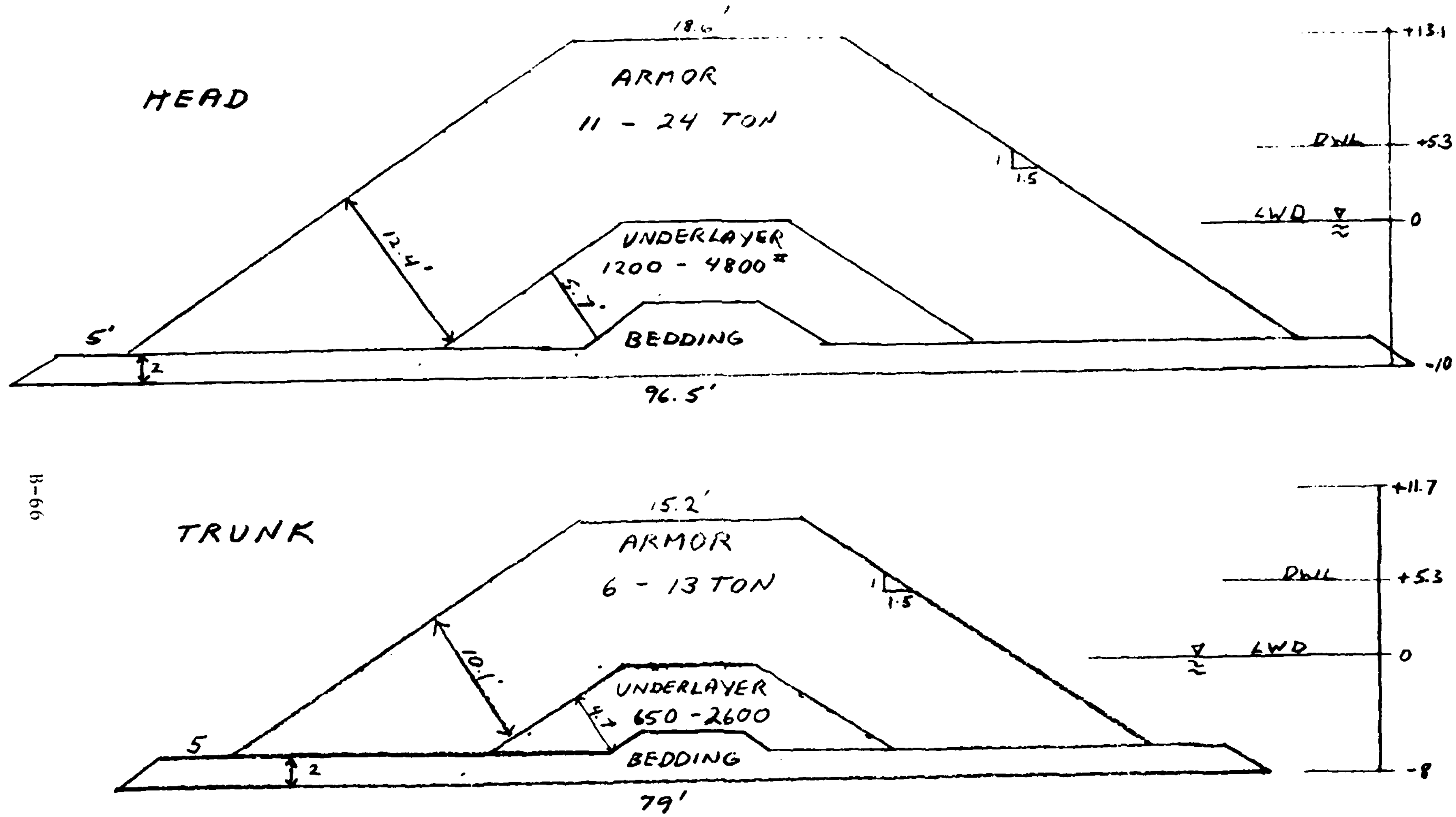
$$Hbi = 11.6\left(1.04 - \frac{3.0}{(0.54)(11.3)}\right) = 6.4'$$

CREST HEIGHT = 6.4 + 5.3 = 11.7 above LWD in order to meet design criterion of a 3.0' maximum interior wave in the entrance channel.

NCD Form 14 1 APR 6 Previous edition may be used until supply is exhausted.




PLAN 4 - EAST BREAKWATER




PLAN 4 - WEST BREAKWATER

GENEVA-ON-THE LAKE, OHIO

SMALL BOAT HARBOR

TABLE B-3 DESIGN SUMMARY FOR BREAKWATER STRUCTURE

| Alternative X-Section | Sounding | ds | Hi | Crest Width | W(lbs) | Armor Stone Max Tons | Armor Stone Min Tons | Layer Thick | Underlayer Stone Max Lbs | Underlayer Stone Min Lbs | Layer Thick | Bedding Max Lbs | Bedding Min Lbs | H'o | Crest Height |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Plan No. 1** | | | | | | | | | | | | | | | |
| East Breakwater - Head | 6.5 | 11.8' | 9.9'* | 14.1' | 10665 | 10.7 | 4.8 | 9.4' | 2133 | 533 | 4.4' | 107 | 1 1/3 | 9.5 | 10' |
| East Breakwater - Trunk | 4. ' | 9.3' | 7.9'* | 10.6' | 4490 | 4.5 | 2.0 | 7.1' | 898 | 224 | 3.3 | 45 | 0.6 | 7.2 | 8 |
| West Breakwater - Head | 8.8' | 14.1' | 11.8'* | 16.8' | 18058 | 18.0 | 8.1 | 11.2' | 3612 | 903 | 5.2' | 181 | 2 1/4 | 11.3 | 12.3 |
| West Breakwater - Dogleg | 8' | 13.3' | 11.2'* | 15.0' | 12794 | 12.8 | 5.8 | 10.0' | 2559 | 640 | 4.6' | 128 | 1.6 | 11.3 | 12.3 |
| West Breakwater - Trunk | 6' | 11.3' | 9.6'* | 12.9' | 8057 | 8.1 | 3.6 | 8.6' | 1611 | 403 | 4.0' | 81 | 1 | 9.2 | 9.9 |
| Interior Breakwater | 1' | 6.3' | 3 '* | 4.4 | 298 | 593 lbs | 267 lbs | 2.9' | 59 | 15 | 1.3' | - | - | 3.0 | 6.8 |
| **Plan No. 2** | | | | | | | | | | | | | | | |
| East Breakwater - Head | 11.5 | 16.8 | 13.4 | 18.5 | 23966 | 24.0 | 10.8 | 12.3' | 4793 | 1198 | 5.7' | 240 | 3 | 11.5 | 13.7 |
| East Breakwater - Trunk | 8 | 13.3 | 9.3 | 11.9 | 6409 | 6.4 | 2.9 | 8.0 | 1282 | 320 | 3.7 | 64 | 0.8 | 9.2 | 14.8 |
| West Breakwater - Head | 10.8 | 16.1 | 13.4 | 18.5 | 23966 | 24.0 | 10.8 | 12.3 | 4793 | 1198 | 5.7 | 240 | 3 | 11.5 | 14.0 |
| West Breakwater - Trunk | 6 | 11.3 | 9.6 * | 12.9 | 8057 | 8.1 | 3.6 | 8.6 | 1611 | 403 | 4.0 | 81 | 1 | 8.8 | 13.9 |
| Sand Trap Breakwater | 4 | 9.3 | 7.9 * | 11.3 | 5419 | 5.4 | 2.4 | 7.5 | 1084 | 271 | 3.5 | 54 | 0.7 | 7.2 | 8.2 |
| **Plan No. 3** | | | | | | | | | | | | | | | |
| East Breakwater - Head | 7 | 12.3 | 10.5* | 15.0 | 12723 | 12.7 | 5.7 | 10.0 | 2545 | 636 | 4.6 | 127 | 1.6 | 10.1 | 10.8 |
| East Breakwater - Trunk | 5 | 10.3 | 8.8* | 11.8 | 6206 | 6.2 | 2.8 | 7.9 | 1241 | 310 | 3.7 | 62 | 0,8 | 8.4 | 8.9 |
| West Breakwater - Head | 11.5 | 16.8 | 13.5 | 18.7 | 24506 | 24.5 | 11.0 | 12.4 | 4901 | 1225 | 5.8 | 245 | 3.1 | 11.5 | 13.4 |
| West Breakwater - Trunk | 8. | 13.3 | 11.3* | 15.2 | 13140 | 13.1 | 5.9 | 10.1 | 2628 | 657 | 4.7 | 131 | 1.6 | 10.3 | 11.7 |
| **Plan No. 4** | | | | | | | | | | | | | | | |
| East Breakwater - Head | 8 | 13.3 | 11.3* | 16.1 | 15859 | 15.9 | 7.1 | 10.8 | 3171 | 793 | 5.0 | 159 | 2 | 10.3 | 11.7 |
| East Breakwater - Trunk | 6 | 11.3 | 9.6* | 12.9 | 8057 | 8.1 | 3.6 | 8.6 | 1611 | 403 | 4.0 | 81 | 1 | 9.2 | 9.7 |
| West Breakwater - Head | 10 | 15.3 | 13.0* | 18.6 | 24147 | 24.1 | 10.9 | 12.4 | 4829 | 1207 | 5.7 | 241 | 3 | 11.5 | 13.1 |
| West Breakwater - Trunk | 8 | 13.3 | 11.3* | 15.2 | 13140 | 13.1 | 5.9 | 10.1 | 2628 | 657 | 4.7 | 131 | 1.6 | 10.3 | 11.7 |

* Indicates breaking waves; otherwise wave is non-breaking

APPENDIX B1

INITIAL ALTERNATIVES CONSIDERED

GENEVA-ON-THE-LAKE SMALL-BOAT HARBOR

STAGE 2 REPORT
OF
REFORMULATION PHASE I GENERAL DESIGN MEMORANDUM

1. Memorandum describing initial alternatives

U. S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, NY 14207

# DISPOSITION FORM

For use of this form, see AR 340-15, the proponent agency is TAGCEN.

| REFERENCE OR OFFICE SYMBOL | SUBJECT |
|---|---|
| NCBED-DC | Geneva State Park Small-Boat Harbor Preliminary Alternative Plans |

TOXXX THRU: Chief, Engr. Div. FROM Chief, Design Br. DATE 20 Nov 1978 CMT 1

Pope/2229

TO: Chief, Planning Br.
ATTN: Western Basin

1. Reference Mr. Richard Aguglia's oral request for Coastal Section to develop a number of offshore and onshore alternatives for the subject small-boat harbor. Eight such alternatives were developed, including two at Cowles Creek, and are enclosed.

2. Two different levels of harbor intent are presented:

a. An all-weather marina and harbor-of-refuge having 500,000 square feet of mooring area. All variations of this type of harbor require breakwater structures, have an eight-foot deep, 150-foot wide entrance, 200 feet between structure ends, and no less than a six-foot deep mooring area.

b. A fair-weather harbor, including a launching area and trailer-drawn boat berthing, having about 200,000 square feet of area. This type of harbor requires minimum structures to reduce shoaling, has a six-foot deep, 150-foot wide entrance, and 200 feet between structure ends.

3. All presented breakwater configurations are tentatively planned to be of rubble-mound construction (high rock elevation precludes the use of driven sheet pile.) Structure cross sections and armor stone sizes have not been developed due to the number of alternatives and the project's uncertainty. However, it is expected that those structures which are intended to protect moored boats will need a higher crest height (for example, +16 to +20 feet) then those which are intended only to maintain a safe entrance (for example, +10 to +14 feet.) Those structures which are designed to stop shoaling at the fair-weather harbor entrance can probably be designed with an even lower crest elevation (for example, approximately +8.)

4. Per Mr. Aguglia's request these alternatives are meant to be a schematic approximation of the range of possibilities that exist. Some of the developed alternatives would not normally be recommended by Coastal Section, but are presented simply as an attempt to come up with a possible plan for an acceptable location. With each alternative we have tried to develop plans which comply with the restrictions of rock elevation, the wetland areas, offshore contours, and existing park facilities (including the parking lot) while maintaining a reasonable engineering and economic balance.

5. There are some important gaps in the offshore contour data and conflicts in the rock elevation data. We have attempted to make reasonable assumptions in both cases but future clarification will be necessary. Such things as breakwater length, entrance channel location and mooring area configuration may need to be further manipulated once this data is available.



DA FORM 1 FEB 62 2496 REPLACES DD FORM 96, WHICH IS OBSOLETE.

NCBED-DC
SUBJECT: Geneva State Park Small-Boat Harbor Preliminary Alternative Plans

6. Those plans which involve portions of the wetland area west of the bathhouse are designed to include the borderline high grass area. Open water and submerged areas were avoided where possible.

7. We believe Plans 2, 3, and 4 hold the most promise. If you need any additional assistance or refinement concerning these plans, contact Denton Clark or Joan Pope.

Joseph A. Foley
JOSEPH A. FOLEY
Chief, Design Branch

1 Incl
1. Eight harbor alternatives

SUMMARY OF GENEVA STATE PARK
SMALL-BOAT HARBOR

ALTERNATIVES

| Alternative | |
|---|---|
| 1 | 500,000-square foot harbor-of-refuge at Cowles Creek |
| 2 | 500,000-square foot harbor-of-refuge - combination onshore and offshore to west of bathhouse |
| 3 | 500,000-square foot harbor-of-refuge west of bathhouse, major interruption to parking lot |
| 4 | 500,000-square foot harbor-of-refuge west of bathhouse, major interruption to wetland |
| 5 | limited fair-weather harbor at Cowles Creek |
| 6 | limited fair-weather harbor west of bathhouse |
| 7 | 500,000-square foot harbor-of-refuge - totally offshore (2,500 feet of breakwater) |
| 8 | 500,000-square foot harbor-of-refuge - totally offshore (2,200 feet of breakwater) |

## GENEVA STATE PARK

Alternative 1 (See Figure B1-1)

This alternative is for an all-weather boat harbor, marina, and harbor-of-refuge east of the bathhouse. The entrance channel would be eight feet deep. The mooring area could be planned for an eight-foot depth. The entrance channel would be 1,000 feet long and 150 feet wide. The marina-harbor area is 500,000 square feet.

Two breakwaters are planned which include a 400-foot long east breakwater and a 900-foot long doglegged west breakwater.

The bathhouse would be partially isolated and direct access between the bathhouse and the east beach would be severed. Erosion east of the entrance would be intensified. 180,000 square feet of parking lot would be destroyed. Cowles Creek would be intercepted.

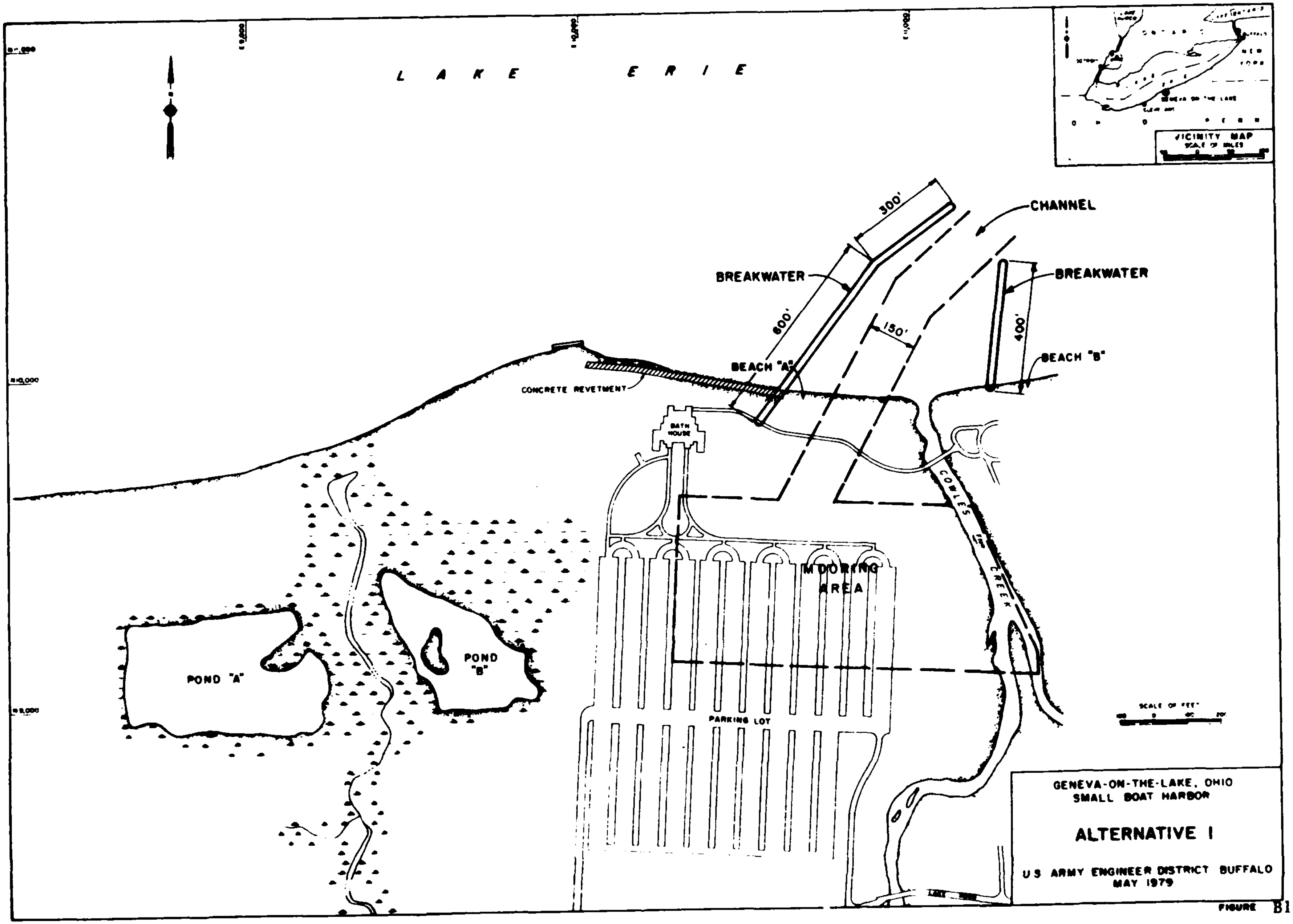

LAKE ERIE
BREAKWATER
300'
600'
CHANNEL
BREAKWATER
400'
150'
BEACH "A"
BEACH "B"
CONCRETE REVETMENT
BATH HOUSE
COWLES CREEK
MOORING AREA
PARKING LOT
POND "A"
POND "B"
VICINITY MAP
SCALE OF MILES
SCALE OF FEET
GENEVA-ON-THE-LAKE, OHIO
SMALL BOAT HARBOR
ALTERNATIVE I
U S ARMY ENGINEER DISTRICT BUFFALO
MAY 1979

FIGURE B1-1

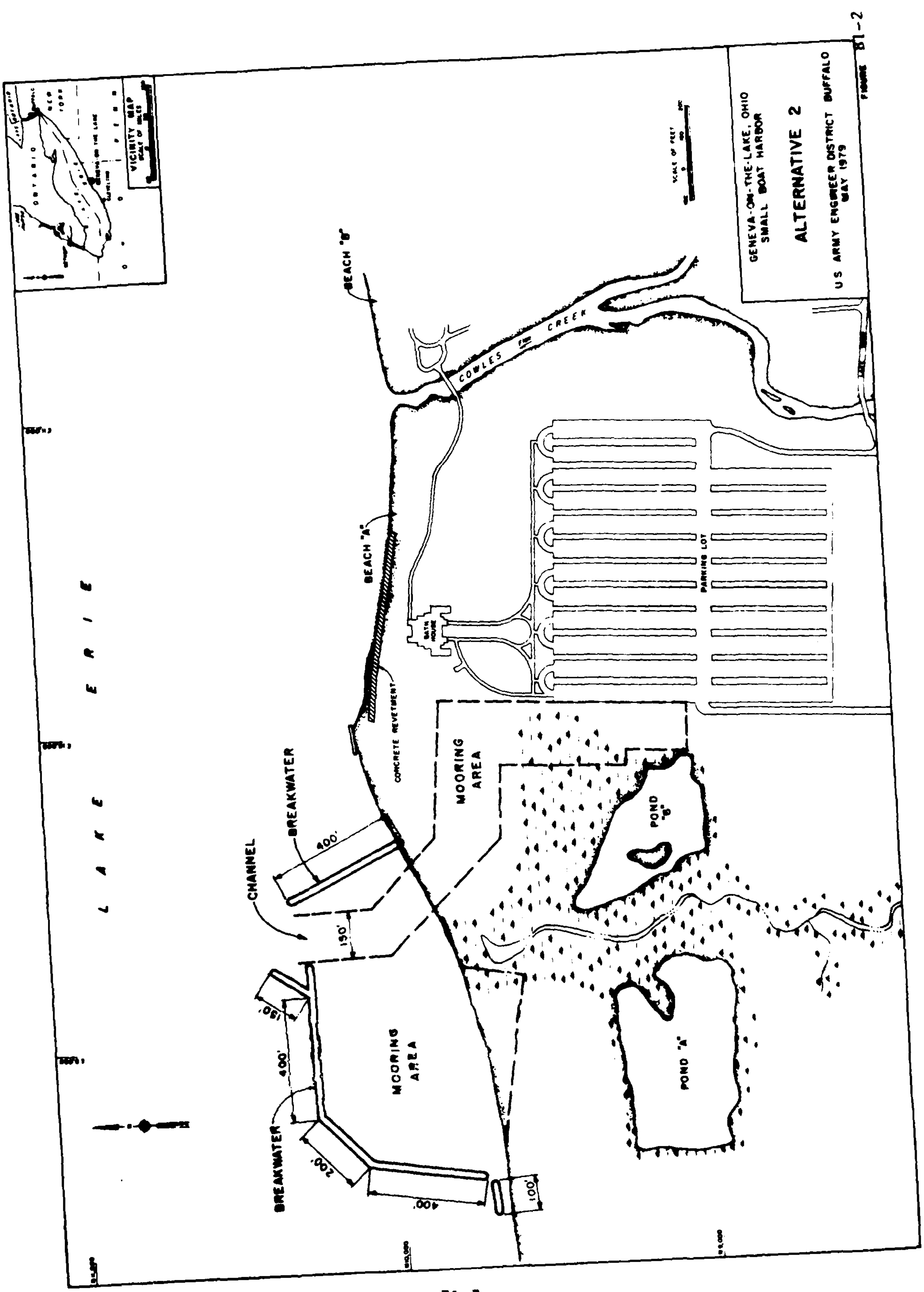
GENEVA STATE PARK

Alternative 2 (See Figure B1-2) Offshore-Onshore

This alternative is for an all-weather boat harbor, marina, and harbor-of-refuge that is part offshore-part onshore. The entrance channel would be eight feet deep and 150 feet wide. Two mooring areas are planned. The offshore mooring area is approximately 300,000 square feet and could be planned for six-foot to eight-foot depth. The onshore mooring area is approximately 200,000 square feet and could be planned for six-foot to eight-foot depth.

The breakwater system would have a total length of 1,650 feet including one small detached, breakwater which would serve as a sand trap. The breakwater which protects the mooring area would need to have a sufficient crest elevation to allow almost no overtopping.

Approximately 90,000 square feet of wetland would need to be mitigated.


LAKE ERIE
VICINITY MAP
BREAKWATER
CHANNEL
400'
190'
130'
200'
100'
MOORING AREA
CONCRETE REVETMENT
BEACH "A"
BEACH "B"
COWLES CREEK
BATH HOUSE
PARKING LOT
POND "A"
POND "B"
SCALE OF FEET
GENEVA-ON-THE-LAKE, OHIO
SMALL BOAT HARBOR
ALTERNATIVE 2
U S ARMY ENGINEER DISTRICT BUFFALO
MAY 1979
FIGURE B1-2

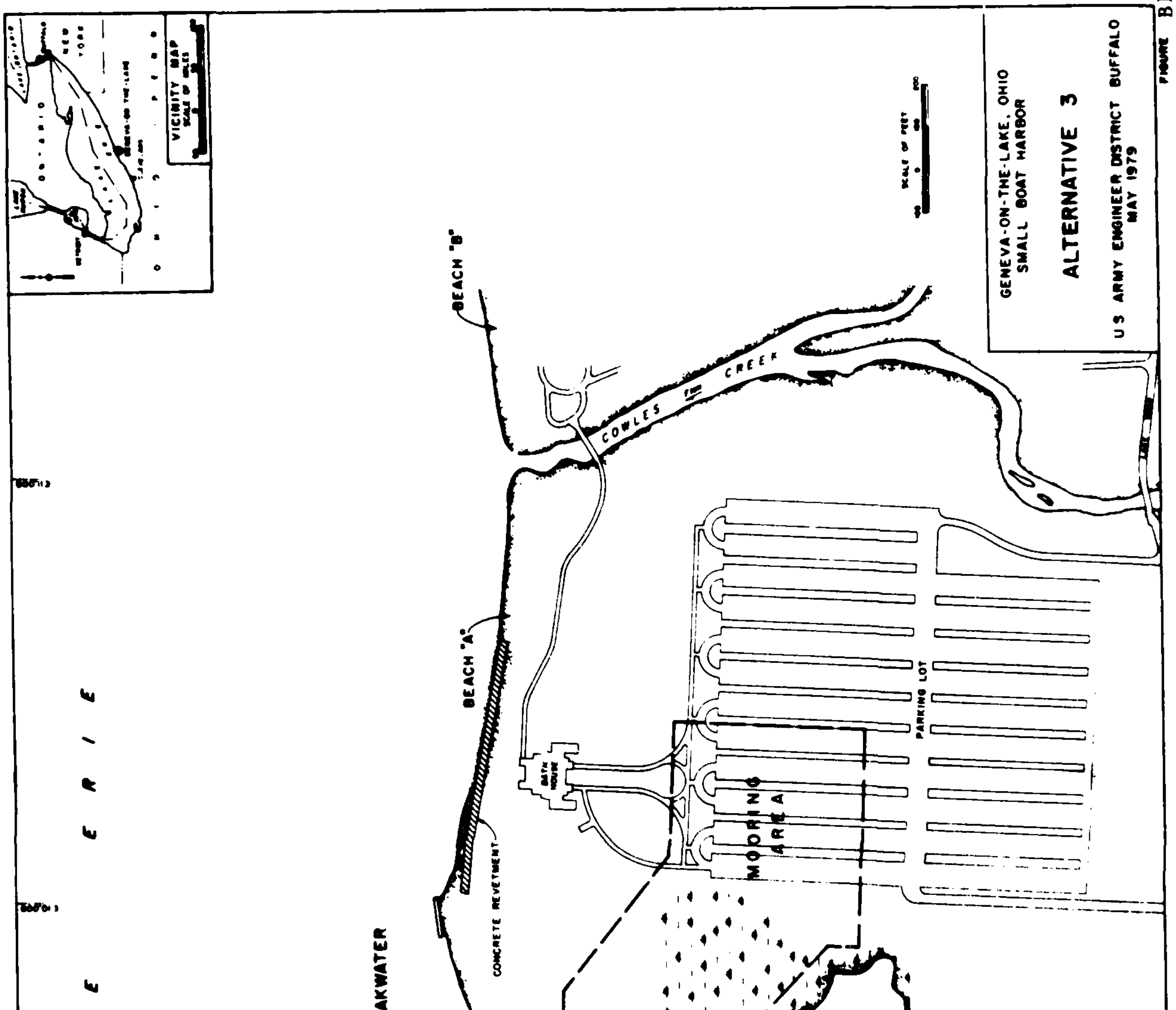
GENEVA STATE PARK

Alternative 3 (See Figure B1-3)

This alternative is for an all-weather, boat harbor, marina, and harbor-of-refuge west of the bathhouse. The entrance channel would be eight feet deep. The mooring area could be planned for up to eight-foot depth. The entrance channel would be 400 feet long and 150 feet wide. The marina-harbor area is approximately 500,000 square feet.

Two arrowhead breakwaters are planned, including a 700-foot long west breakwater and a 300-foot long east breakwater.

140,000 square feet of parking lot would be destroyed. Approximately 150,000 square feet of wetlands would be excavated.



LAKE ERIE
VICINITY MAP
BEACH "B"
COWLES CREEK
BEACH "A"
BATH HOUSE
PARKING LOT
MOORING AREA
CONCRETE REVETMENT
BREAKWATER
300'
CHANNEL
150'
BREAKWATER
700'
POND "B"
POND "A"
SCALE OF FEET
GENEVA-ON-THE-LAKE, OHIO
SMALL BOAT HARBOR
ALTERNATIVE 3
U S ARMY ENGINEER DISTRICT BUFFALO
MAY 1979
FIGURE B1-3

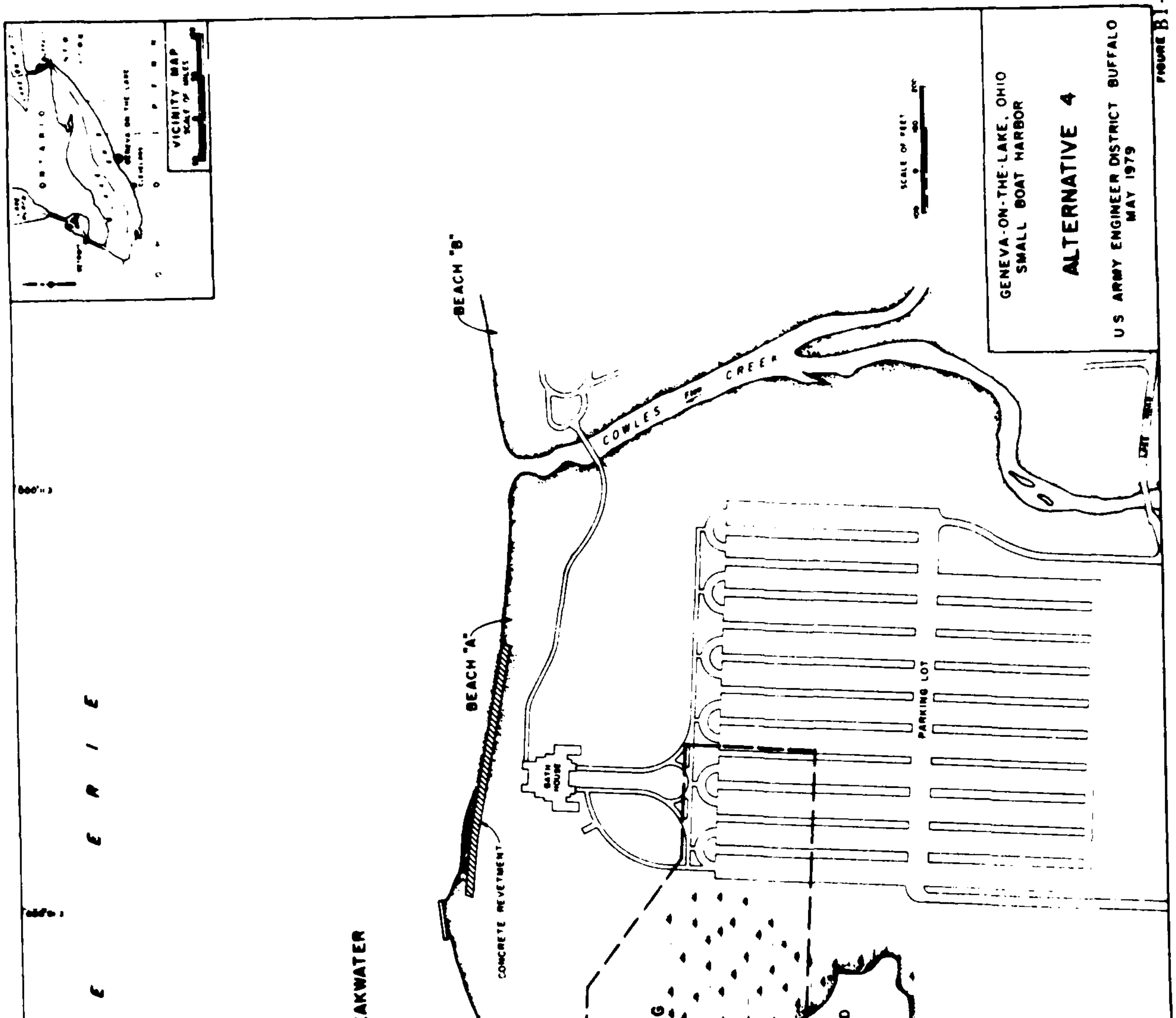
GENEVA STATE PARK

Alternative 4 (See Figure B1-4)

This alternative is for an all-weather boat harbor, marina, and harbor-of-refuge west of the bathhouse. The entrance channel would be eight feet deep. The mooring area could be planned for up to eight-foot depth. The entrance channel would be 400 feet long and 150 feet wide. The marina-harbor area is 500,000 square feet.

Two arrowhead breakwaters are planned which include a 700-foot long west breakwater and a 300-foot long east breakwater.

60,000 square feet of parking lot would be destroyed. Approximately 300,000 square feet of wetlands (including 40,000 square feet of pond) would be excavated.

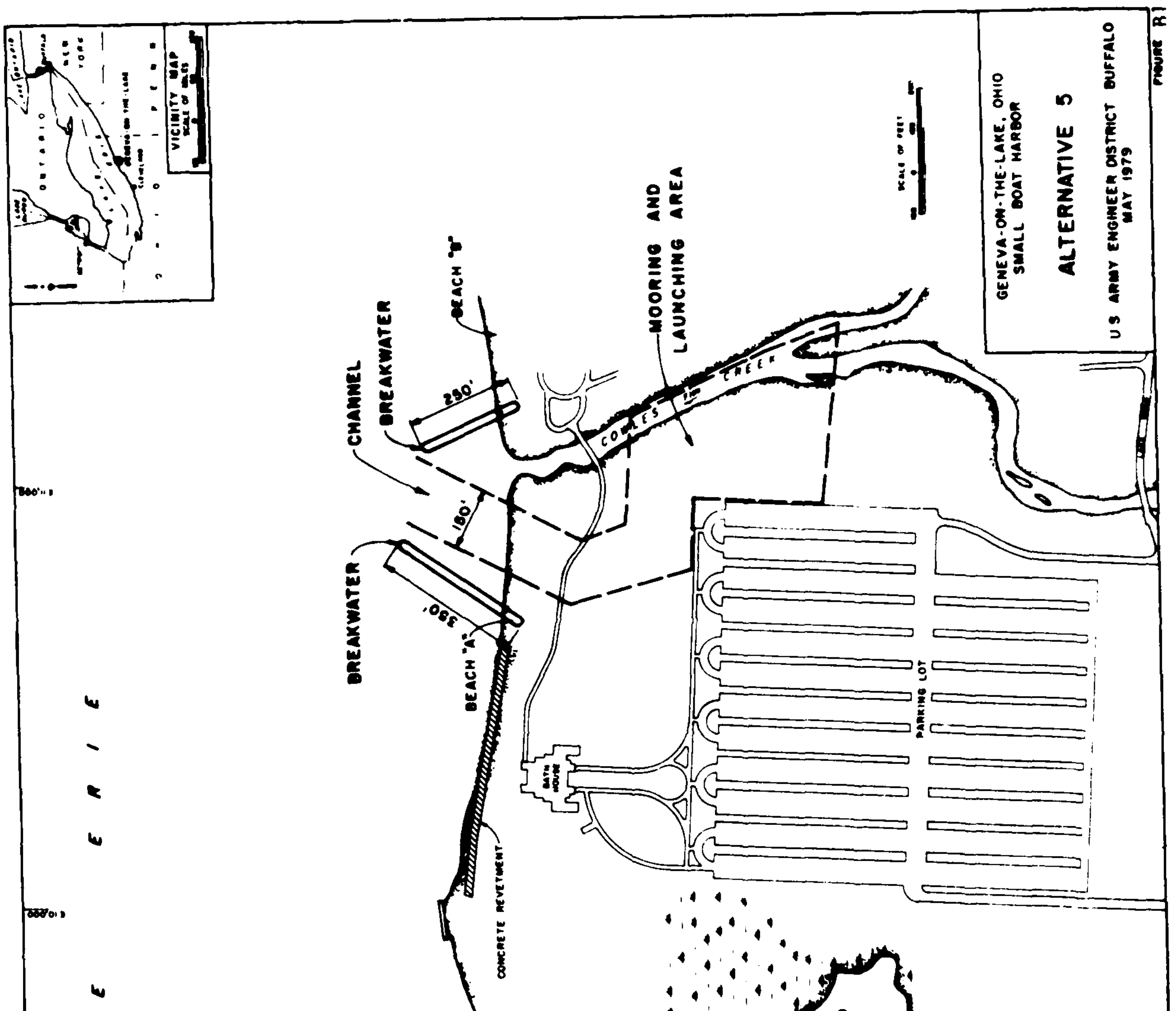

GENEVA-ON-THE-LAKE, OHIO
SMALL BOAT HARBOR
ALTERNATIVE 4
US ARMY ENGINEER DISTRICT BUFFALO
MAY 1979
FIGURE B1-4
VICINITY MAP
LAKE ERIE
BREAKWATER
300'
CHANNEL
150'
BREAKWATER
700'
MOORING AREA
POND "A"
POND "B"
CONCRETE REVETMENT
BEACH "A"
BATH HOUSE
PARKING LOT
BEACH "B"
COWLES CREEK

GENEVA STATE PARK

Alternative 5 (See Figure B1-5)

This alternative is for a fair-weather, small-boat, non-marina, harbor and launching area. The entrance channel would be planned for a six-foot depth, a 150-foot width, and a 600-foot length. The launching and mooring area would have a 200-foot to 450-foot width and a 700-foot length. (≈ Area = 200,000 square feet.) Two modified arrowhead breakwaters are planned, one 350 feet and one 250 feet.

Direct access between the bathhouse and the beach would be severed. Erosion of the shore east of the entrance would be intensified.


LAKE ERIE
BREAKWATER
CHANNEL
BREAKWATER
250'
180'
350'
BEACH "A"
BEACH "B"
MOORING AND LAUNCHING AREA
COWLES CREEK
BATH HOUSE
PARKING LOT
CONCRETE REVETMENT
POND "A"
POND "B"
VICINITY MAP
GENEVA-ON-THE-LAKE, OHIO
SMALL BOAT HARBOR
ALTERNATIVE 5
US ARMY ENGINEER DISTRICT BUFFALO
MAY 1979
FIGURE B1-5

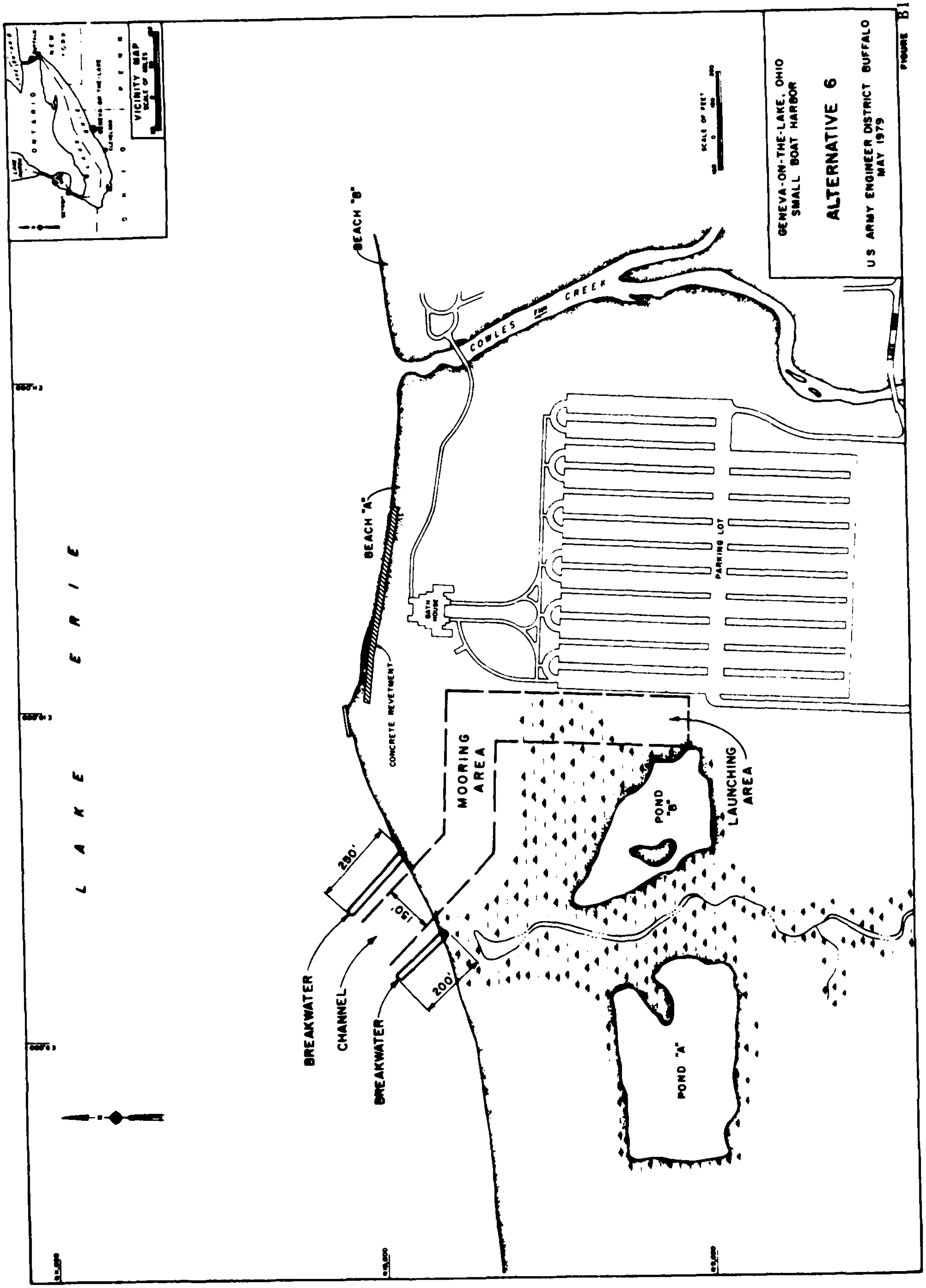
GENEVA STATE PARK

Alternative 6 (See Figure B1-6)

This alternative is for a fair-weather, small-boat, non-marina, harbor and launching area. The channel would be planned for a six-foot depth and would have a 150-foot width. Total channel length equals 1,500 feet. ( Area = 225,000 square feet.) For 700 feet of the channel, a 50-foot width would be set aside for short-term mooring. 400 feet of the channel would be available for multiple launching area.

One 200-foot long and one 250-foot long parallel jetties are planned to prevent shoaling. An arrowhead arrangement is also possible.

Approximately 82,500 square feet of wetlands would be dredged. One lane of the parking lot would be converted into a launching ramp access.


LAKE ERIE
VICINITY MAP
BEACH "B"
COWLES CREEK
BEACH "A"
BATH HOUSE
PARKING LOT
CONCRETE REVETMENT
MOORING AREA
LAUNCHING AREA
POND "B"
POND "A"
250'
150'
200'
BREAKWATER
CHANNEL
BREAKWATER
GENEVA-ON-THE-LAKE, OHIO
SMALL BOAT HARBOR
ALTERNATIVE 6
U S ARMY ENGINEER DISTRICT BUFFALO
MAY 1979
FIGURE B1-6

GENEVA STATE PARK

Alternative 7 (See Figure B1-7) Offshore

This alternative is for an all-weather, boat harbor, marina, harbor-of-refuge constructed totally offshore. The entrance channel would be eight feet deep, 200 feet long, and 150 feet wide. The mooring area could be planned for eight-foot, six-foot, or four-foot depths according to navigation needs and top of rock data. The mooring area is 500,000 square feet.

The breakwater system would have a total length of 2,500 feet in length including two small detached breakwaters which would serve as sand traps. The breakwaters would need to have a sufficient crest elevation to allow almost no overtopping.

Access to moored boats may be a problem.

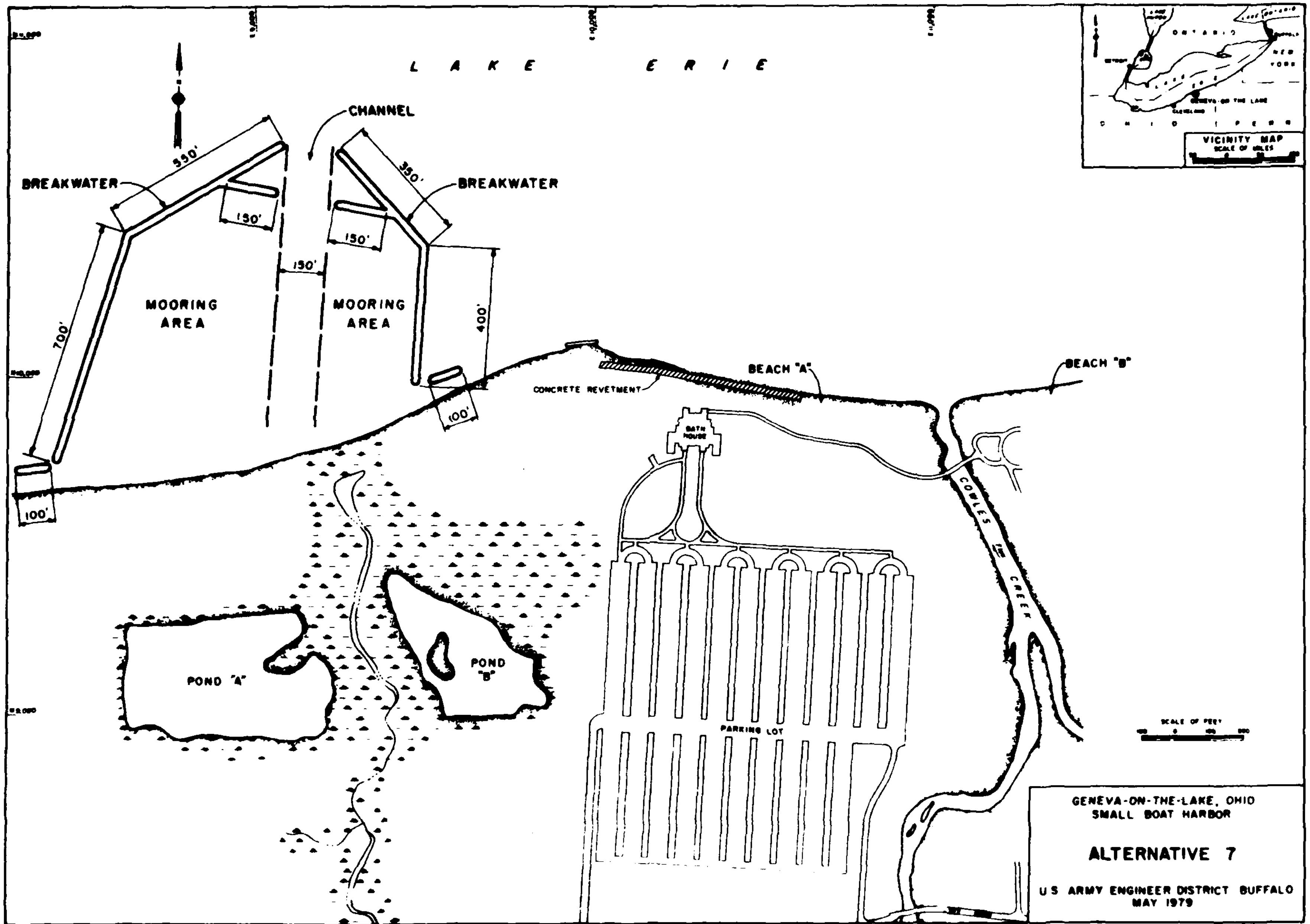

LAKE ERIE
CHANNEL
BREAKWATER
BREAKWATER
350'
350'
150'
150'
150'
700'
400'
100'
100'
MOORING AREA
MOORING AREA
CONCRETE REVETMENT
BEACH "A"
BEACH "B"
BATH HOUSE
PARKING LOT
POND "A"
POND "B"
COWLES CREEK
VICINITY MAP
SCALE OF FEET
GENEVA-ON-THE-LAKE, OHIO
SMALL BOAT HARBOR
ALTERNATIVE 7
US ARMY ENGINEER DISTRICT BUFFALO
MAY 1979

FIGURE R1-7

## GENEVA STATE PARK

Alternative 8 (See Figure B1-8) Offshore

This alternative is for an all-weather boat harbor, marina, and harbor-of-refuge constructed totally offshore. The entrance channel would be eight feet deep. The mooring area could be planned for eight feet in some areas, but six feet for most of it. The entrance channel would be about 300 feet long and 150 feet wide. The mooring harbor area is 500,000 square feet.

The breakwater system would have a total length of 2,200 feet in length and would have to have a crest elevation sufficient to allow almost no overtopping.

Access to the moored boats may be a problem. The planned entrance may be difficult to enter during NE storms,

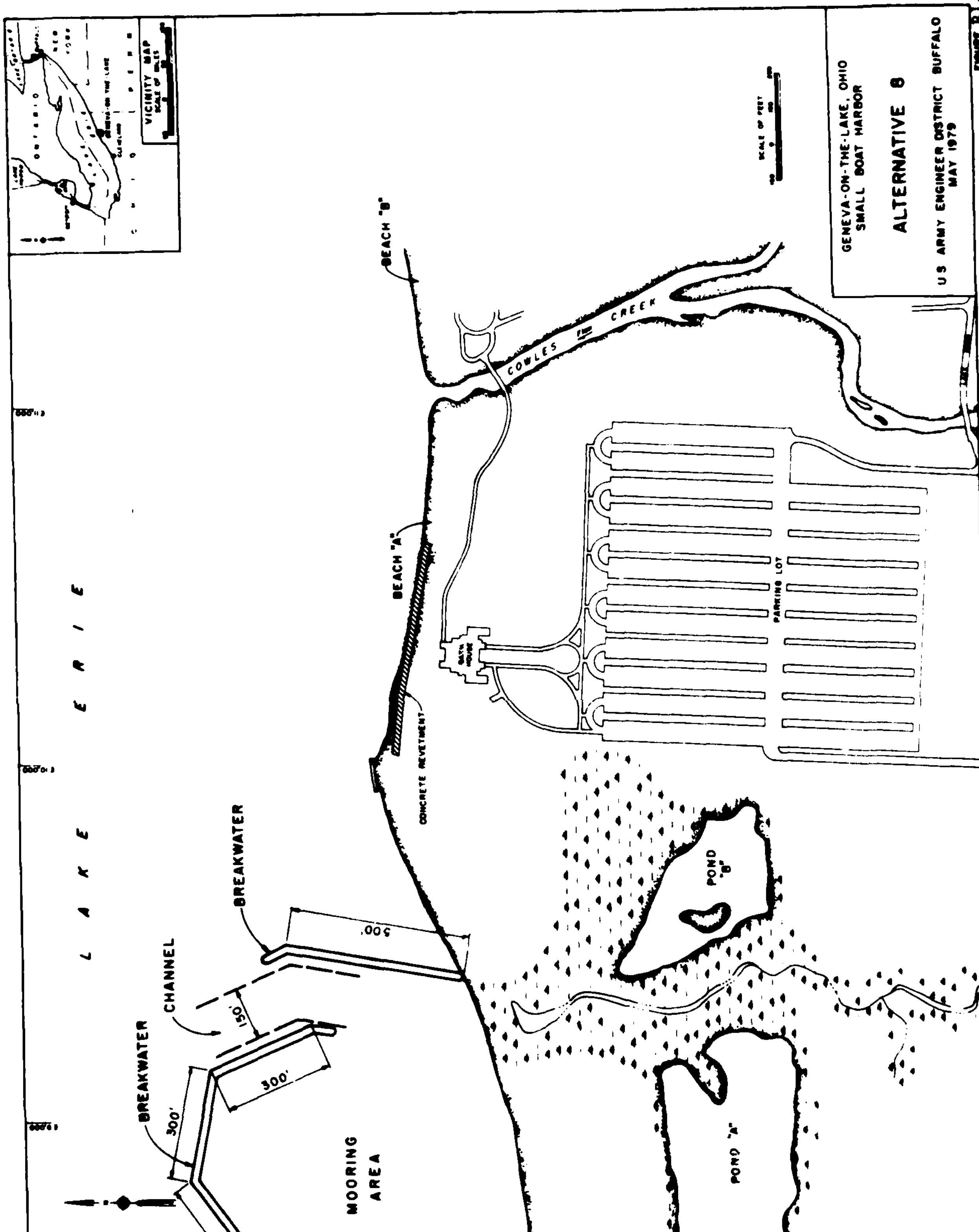

GENEVA-ON-THE-LAKE, OHIO
SMALL BOAT HARBOR
ALTERNATIVE 8
US ARMY ENGINEER DISTRICT BUFFALO
MAY 1979
VICINITY MAP
LAKE ERIE
BEACH "B"
COWLES CREEK
BEACH "A"
PARKING LOT
CONCRETE REVETMENT
BREAKWATER
CHANNEL
BREAKWATER
500'
150'
300'
300'
400'
700'
100
MOORING AREA
POND "B"
POND "A"

FIGURE B1-8

APPENDIX C

COST ESTIMATES
FOR
ALTERNATIVES 1 THROUGH 4

GENEVA-ON-THE-LAKE SMALL-BOAT HARBOR

STAGE 2 REPORT
OF
REFORMULATION PHASE I GENERAL DESIGN MEMORANDUM

U. S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, NY 14207

GENEVA-ON-THE-LAKE, OHIO

GENERAL DESIGN MEMORANDUM
PHASE I
STAGE 2 REPORT

APPENDIX C
COST ESTIMATES

TABLE OF CONTENTS

## C1. PURPOSE

The purpose of this appendix is to present information to assist in review of the estimate of cost for the alternatives considered in formulating a selected plan of improvement at Geneva-on-the-Lake, OH.

## C2. INFORMATION

Information available in the District Office to prepare the estimate consisted of soundings and topography over the entire area being considered for alternative plans 1, 2, 3, and 4. The subsurface information was obtained from a Seismic Study performed in August-September 1978, and the Soil Boring Program performed for the 1969 Interim Report.

## C3. PRINCIPAL ITEMS

Alternatives considered in formulating a selected plan of improvements are described in detail in the main report. The principal items of work are channel dredging and breakwater construction. These items are discussed in the following paragraphs.

C4. Rubblemound breakwaters for the alternatives were determined to be the best suited to minimize wave build-up and reflection. Size and quantity of stone are based upon design considerations discussed in Appendix B. Unit prices for stone were taken from similar work accomplished in the area, and updated to May 1979 price levels.

C5. The dredging quantities for the selected plan are based upon soundings in the areas to be dredged and the volume of material to be excavated was estimated from cross-sections drawn based on the subsurface information obtained. An overdepth of one foot and side-slopes of one vertical on three horizontal for earth (overburden) and till material and a vertical slope for rock have been used in determination of quantities. It was assumed that dredging (underwater excavation) would be performed by dragline for near shore material and a hydraulic dredge with an attendant plant for material further out into the lake. The excavation would be done by a self-propelled scraper with the material being truck-loaded and hauled approximately one mile to be stockpiled. Any lake site if needed would be fully coordinated with the USFWS, EPA, ODNR, and other affected interests as will the advisability of using the sandy cobble material for beach nourishment. A sufficient amount of contingency and cost is contained in the dredging estimate to reflect possible disposal of some of the material by other methods including lake and land disposal. Unit cost is based generally upon similar dredging work done on Lake Erie.

## C6. ESTIMATE OF LANDS AND DAMAGES

Although all land required for the project is within Geneva State Park (classified as recreation land), and no actual out-of-pocket expense would be required, the economic value of the land must be charged against the project. Also involved in Alternatives No. 1 and No. 3 is a substantial portion of a paved parking lot and access to a bathhouse built by the State of Ohio in 1968 at a cost in excess of $250,000. For estimating purposes this construction cost for the bathhouse was converted to May 1979 price levels, of approximately $600,000, using the Engineering News Record's "Construction Price Index." A depreciation factor of 15 percent was applied for access restrictions to the bathhouse for Alternatives No. 1 and No. 3. Lakefront land along the southern shore of Lake Erie generally ranges from $100 to $500 per front foot and $1,500 to $4,000 per acre for upland. The estimate of the first cost of land and damages for the four alternatives is shown in Table C1.

Table Cl - Estimate of Lands and Damages

| Item | Quantity | Unit | Unit Cost | Amount |
|---|---|---|---|---|
| | | | $ | $ |
| Alternative No. 1 | | | | |
| Lakefront | 500 | feet | 150 | 75,000 |
| Developed Recreation Land | 14 | acres | 3,500 | 49,000 |
| Depreciation to Bathhouse | | L.S. | | 90,000 |
| Improved Parking Lot [1/] | 400,000 | S.F. | 1 | 400,000 |
| Total | | | | 614,000 |
| Alternative No. 2 | | | | |
| Lakefront | 1,200 | feet | 150 | 180,000 |
| Partially Developed Recreation Land | 7 | acres | 2,500 | 17,500 |
| Total | | | | 197,500 |
| Alternative No. 3 | | | | |
| Lakefront | 800 | feet | 150 | 120,000 |
| Partially Developed Recreation Land | 14 | acres | 3,000 | 42,000 |
| Depreciation to Bathhouse | | L.S. | | 90,000 |
| Improved Parking Lot [1/] | 240,000 | S.F. | 1 | 240,000 |
| Total | | | | 492,000 |
| Alternative No. 4 | | | | |
| Lakefront | 600 | feet | 150 | 90,000 |
| Recreation Land | 14 | acres | 2,500 | 35,000 |
| Improved Parking Lot | 10,000 | S.F. | 1 | 10,000 |
| Total | | | | 135,000 |

[1/] Costs in addition to land costs for parking facilities.

C7. ESTIMATE OF FIRST COST OF CONSTRUCTION AND ANNUAL OPERATION AND MAINTENANCE COST

The estimated first cost for the four alternatives considered in this Stage 2 report, based on May 1979 prices, are shown in Tables C2 through C5 inclusive. Handrails are a necessary feature of recreational facilities for fishing from shore connected breakwaters and are also necessary for public safety. The harbor project can be constructed without recreation facilities but must include handrails. The cost for handrails shown would be added to the breakwater cost of the project if recreation facilities are not constructed.

C8. The annual operation and maintenance costs associated with each alternative is also shown in Tables C2 through C5. These costs are based upon past experience for similar maintenance work done in the Buffalo District in maintaining harbor channels and breakwaters. The annual maintenance cost for maintaining the aids to navigation were updated from the Interim Report by price level and were originally furnished by the Ninth Coast Guard District.

C9. ESTIMATE OF SELF-LIQUIDATING COSTS

The above cost estimates do not include the self-liquidating cost associated with each alternative for the mooring area, launching ramps and public service facilities currently estimated at: 1) $4,150,000 for Alternative No. 1; 2) $3,580,000 for Alternative No. 2; 3) $4,130,000 for Alternative No. 3; and 4) $3,780,000 for Alternative No. 4. These self-liquidating facilities are the responsibility of the non-Federal sponsor, ODNR. In addition, because these facilities are considered self-liquidating they do not enter into the benefit-cost analysis as presented in Appendix D.

C10. ESTIMATE OF ANNUAL CHARGES

The estimated investment costs, project costs and annual charges for the four alternatives are presented in Tables C6 through C9, inclusive. It is assumed construction would require two construction seasons, therefore interest during construction has been included. The interest and amortization rates used are 6-7/8 percent in accordance with the Water Resources Council Regulation. The economic life of the project is assumed to be 50 years.

| REASONABLE CONTRACT ESTIMATE TABLE C2 | | | | | SHEET 1 OF 2 |
|---|---|---|---|---|---|
| PROJECT Geneva-on-the-Lake, OH Small Boat Harbor<br>Alternative No. 1 Project Costs (May 1979 P.L.) | | | | | INVITATION NO. |
| ITEM NO. | DESCRIPTION | ESTIMATED QUANTITY | UNIT | UNIT PRICE | ESTIMATED AMOUNT |
| 02. | Relocation | | | | |
| | Footbridge Removal | | LS | | 10,000 |
| | Contingency | | | | 2,000 |
| | Total | | | | 12,000 |
| 09. | Channels | | | | |
| | Mob & Demob | | LS | | 50,000 |
| | Dredging | 10,925 | CY | 8.00 | 87,400 |
| | Excavation | | | | |
| | Overburden | 47,919 | CY | 3.25 | 155,737 |
| | Till | 35,466 | CY | 6.00 | 212,796 |
| | Rock | 6,096 | CY | 18.00 | 109,728 |
| | Retaining Wall | 1,035 | LF | 605.00 | 626,175 |
| | Contingencies | | | | 223,164 |
| | Total | | | | 1,465,000 |
| 10. | Breakwaters | | | | |
| | Mob & Demob | | LS | | 50,000 |
| | Armor Stone 5-25 Tons | 18,612 | TN | 30.00 | 558,346 |
| | 2-5 Tons | 4,935 | TN | 32.00 | 157,920 |
| | Underlayer 0.5-2.5 Tons | 1,606 | TN | 26.00 | 41,734 |
| | 0.25-1.0 Tons | 2,041 | TN | 27.50 | 56,107 |
| | 0.05-0.5 Tons | 1,576 | TN | 29.00 | 45,687 |
| | Bedding 1-250 lb | 8,802 | TN | 21.00 | 184,833 |
| | Sand Bypass Pipe | | LS | | 108,000 |
| | Contingencies | | | | 239,373 |
| | Total | | | | 1,442,000 |
| 14. | Recreational Facilities | | | | |
| | Handrail | 1150 | LF | 10.23 | 11,765 |
| | Walkway | 510 | CY | 144.48 | 73,685 |
| | Contingencies | | | | 18,550 |
| | Total | | | | 104,000 |
| 30. | Engineering and Design | | LS | | 738,000 |
| 31. | Supervision and Administration | | LS | | 229,000 |
| | Subtotal | | | | 3,990,000 |
| | Aids to Navigation | 2 | EA | 12,000 | 24,000 |
| | Total | | | | 4,014,000 |

ENG FORM APR 67 1738 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

| REASONABLE CONTRACT ESTIMATE TABLE C2 (con't) | | | | | SHEET 2 OF 2 |
|---|---|---|---|---|---|
| PROJECT Geneva-on-the-Lake, OH Small Boat Harbor Alternative No. 1 Project Costs (May 1979 P.L.) | | | | | INVITATION NO. |
| ITEM NO. | DESCRIPTION | ESTIMATED QUANTITY | UNIT | UNIT PRICE | ESTIMATED AMOUNT |
| | Lands and Damages | | LS | | 614,000 |
| | Footbridge and Sidewalk | | LS | | 101,000 |
| | Contingencies | | | | 20,000 |
| | Subtotal | | | | 121,000 |
| | Total | | | | 4,749,000 |
| | Annual Maintenance | | | | |
| | Channels and Breakwaters | | | | 38,500 |
| | Aids to Navigation | | | | 900 |
| | Recreation | | | | 5,000 |
| | Total | | | | 44,400 |
| | Non-Federal Costs | | | | 2,730,000 |
| | 50% of Project Costs less Aids to Navigation | | | | (1,995,000) |
| | Cash Contribution for Navigation | | | | 1,930,000 |
| | Cash Contribution for Recreation | | | | 65,000 |
| | Lands and Damages | | | | (614,000) |
| | Footbridge and Facilities | | | | (121,000) |
| | Federal Costs | | | | 2,019,000 |
| | 50% of Project Costs | | | | (1,995,000) |
| | Aids to Navigation | | | | (24,000) |

ENG FORM 1738 APR 67 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

| REASONABLE CONTRACT ESTIMATE TABLE C3 | | | | | SHEET 1 OF 2 |
|---|---|---|---|---|---|
| PROJECT Geneva-on-the-Lake, OH Small Boat Harbor Alternative No. 2 Project Costs (May 1979 P.L.) | | | | | INVITATION NO. |
| ITEM NO. | DESCRIPTION | ESTIMATED QUANTITY | UNIT | UNIT PRICE | ESTIMATED AMOUNT |
| 09. | Channels | | | | |
| | Mob & Demob | | LS | | 50,000 |
| | Dredging | 1395 | CY | 8.00 | 11,160 |
| | Excavation | | | | |
| | Overburden | 60918 | CY | 3.25 | 197,984 |
| | Till | 53553 | CY | 6.00 | 321,318 |
| | Retaining Wall | 100 | LF | 605.00 | 60,500 |
| | Rip-Rap | 3005 | SY | 37.50 | 112,688 |
| | Contingencies | | | | 126,350 |
| | Total | | | | 880,000 |
| 10. | Breakwaters | | | | |
| | Mob & Demob | | LS | | 50,000 |
| | Armor Stone 5-25 Tons | 2170 | TN | 30.00 | 65,100 |
| | 3.5-8 Tons | 25,508 | TN | 31.00 | 790,748 |
| | 2-5 Tons | 861 | TN | 32.00 | 27,552 |
| | Underlayer 0.5-2.5 Tons | 287 | TN | 26.00 | 7,462 |
| | 0.05-1.0 Tons | 4522 | TN | 27.50 | 124,355 |
| | 0.05-0.5 Tons | 2919 | TN | 29.00 | 84,651 |
| | Bedding 1-250 lb. | 14,413 | TN | 21.00 | 302,673 |
| | Sand Bypass Pipe | | LS | | 216,000 |
| | Contingencies | | | | 354,459 |
| | Total | | | | 2,023,000 |
| 14. | Recreational Facilities | | | | |
| | Handrail | 1900 | LF | 10.23 | 19,437 |
| | Walkway | 850 | CY | 144.48 | 122,808 |
| | Footbridge | | LS | | 42,000 |
| | Contingencies | | | | 40,755 |
| | Total | | | | 225,000 |
| 30. | Engineering and Design | | LS | | 738,000 |
| 31. | Supervision and Administration | | LS | | 234,000 |
| | Subtotal | | | | 4,100,000 |
| | Aids to Navigation | | | | |
| | U.S. Coast Guard | 4 | EA | 12,000 | 48,000 |
| | Total | | | | 4,148,000 |

ENG FORM 1738 APR 67 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

| REASONABLE CONTRACT ESTIMATE TABLE C3 (con't) | | | | | SHEET 2 OF 2 |
|---|---|---|---|---|---|
| PROJECT Geneva-on-the-Lake, OH Small Boat Harbor Alternative No. 2 Project Costs (May 1979 P.L.) | | | | | INVITATION NO. |
| ITEM NO. | DESCRIPTION | ESTIMATED QUANTITY | UNIT | UNIT PRICE | ESTIMATED AMOUNT |
| | Lands and Damages | | LS | | 198,000 |
| | Total | | | | 4,346,000 |
| | Annual Maintenance | | | | |
| | Channels and Breakwaters | | LS | | 34,500 |
| | Aids to Navigation | | LS | | 1,700 |
| | Recreation | | LS | | 8,200 |
| | Total | | | | 44,400 |
| | Non-Federal Costs | | | | 2,248,000 |
| | 50% of Project Costs less | | | | |
| | Aids to Navigation | | | | 2,050,000 |
| | Cash Contribution for Navigation | | | | (1,923,000) |
| | Cash Contribution for Recreation | | | | (127,000) |
| | Lands and Damages | | | | 198,000 |
| | Federal Costs | | | | 2,098,000 |
| | 50% of Project Costs | | | | (2,050,000) |
| | Aids to Navigation | | | | (48,000) |

ENG FORM APR 67 1738 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

REASONABLE CONTRACT ESTIMATE TABLE C 4

SHEET 1 OF 2

PROJECT Geneva-on-the-Lake, OH Small Boat Harbor Alternative No. 3 Project Costs (May 1979 P.L.)

INVITATION NO.

| ITEM NO. | DESCRIPTION | ESTIMATED QUANTITY | UNIT | UNIT PRICE | ESTIMATED AMOUNT |
|---|---|---|---|---|---|
| 09. | Channels | | | | |
| | Mob & Demob | | LS | | 50,000 |
| | Dredging | 3,376 | CY | 8.00 | 27,008 |
| | Excavation | | | | |
| | Overburden | 57,646 | CY | 3.25 | 187,350 |
| | Till | 45,495 | CY | 6.00 | 272,970 |
| | Rock | 2,400 | CY | 18.00 | 43,200 |
| | Retaining Wall | 565 | LF | 605.00 | 341,825 |
| | Rip-Rap | 938 | SY | 37.50 | 35,175 |
| | Contingencies | | | | 166,472 |
| | Total | | | | 1,124,000 |
| 10. | Breakwaters | | | | |
| | Mob & Demob | | LS | | 50,000 |
| | Armor Stone 5-25 Tons | 11,116 | TN | 30.00 | 333,480 |
| | 2-5 Tons | 5,028 | TN | 32.00 | 160,896 |
| | Underlayer 0.5-2.5 Tons | 2,317 | TN | 26.00 | 60,242 |
| | 0.05-0.5 Tons | 971 | TN | 29.00 | 28,159 |
| | Bedding 1-250 lb. | 5,208 | TN | 21.00 | 109,368 |
| | Sand Bypass Pipe | | LS | | 108,000 |
| | Contingencies | | | | 170,855 |
| | Total | | | | 1,021,000 |
| 14. | Recreational Facilities | | | | |
| | Handrail | 1050 | LF | 10.23 | 10,742 |
| | Walkway | 465 | CY | 144.48 | 67,184 |
| | Contingencies | | | | 16,074 |
| | Total | | | | 94,000 |
| 30. | Engineering and Design | | LS | | 730,000 |
| 31. | Supervision and Administration | | LS | | 181,000 |
| | Subtotal | | | | 3,150,000 |
| | Aids to Navigation | 2 | EA | 12,000 | 24,000 |
| | Total | | | | 3,174,000 |
| | Lands and Damages | | LS | | 492,000 |
| | Total | | | | 3,666,000 |

ENG FORM 1738 APR 67 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

**REASONABLE CONTRACT ESTIMATE** TABLE C4 (con't) SHEET 2 OF 2

PROJECT Geneva-on-the-Lake, OH Small Boat Harbor
Alternative No. 3 Project Costs (May 1979 P.L.)

INVITATION NO.

| ITEM NO. | DESCRIPTION | ESTIMATED QUANTITY | UNIT | UNIT PRICE | ESTIMATED AMOUNT |
|---|---|---|---|---|---|
| | Annual Maintenance | | | | |
| | Channels and Breakwaters | | LS | | 28,300 |
| | Aids to Navigation | | LS | | 900 |
| | Recreation | | LS | | 4,500 |
| | Total | | | | 33,700 |
| | Non-Federal Costs | | | | 2,067,000 |
| | 50% of Project Costs less Aids to Navigation | | | | (1,575,000) |
| | Cash Contribution for Navigation | | | | 1,520,000 |
| | Cash Contribution for Recreation | | | | 55,000 |
| | Lands and Damages | | | | (492,000) |
| | Federal Costs | | | | 1,599,000 |
| | 50% of Project Costs | | | | (1,575,000) |
| | Aids to Navigation | | | | (24,000) |

ENG FORM 1738 APR 67 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

| REASONABLE CONTRACT ESTIMATE TABLE C 5 | | | | | SHEET 1 OF 2 |
|---|---|---|---|---|---|
| PROJECT Geneva-on-the-Lake, OH Small Boat Harbor Alternative No. 4 Project Costs (May 1979 P.L.) | | | | | INVITATION NO. |
| ITEM NO. | DESCRIPTION | ESTIMATED QUANTITY | UNIT | UNIT PRICE | ESTIMATED AMOUNT |
| 09. | Channels | | | | |
| | Mob & Demob | | LS | | 50,000 |
| | Dredging | 7998 | CY | 8.00 | 63,981 |
| | Excavation | | | | |
| | Overburden | 29069 | CY | 3.25 | 94,475 |
| | Till | 46419 | CY | 6.00 | 278,516 |
| | Retaining Wall | 260 | LF | 605.00 | 157,300 |
| | Contingencies | | | | 106,728 |
| | Total | | | | 751,000 |
| 10. | Breakwaters | | | | |
| | Mob & Demob | | LS | | 50,000 |
| | Armor Stone 5-25 Tons | 9051 | TN | 30.00 | 271,530 |
| | 3.5-8 Tons | 3892 | TN | 31.00 | 120,652 |
| | 2.5-5.5 Tons | 2120 | TN | 32.00 | 67,840 |
| | Underlayer 0.5-2.5 Tons | 1722 | TN | 26.00 | 44,772 |
| | 0.2-0.8 Tons | 756 | TN | 27.00 | 20,790 |
| | 0.05-0.5 Tons | 424 | TN | 29.00 | 12,296 |
| | Bedding 1-250 lb | 4515 | TN | 21.00 | 94,815 |
| | Sand Bypass Pipe | | LS | | 108,000 |
| | Retaining Wall | 220 | LF | 380.00 | 83,600 |
| | Fill | 6200 | TN | 4.26 | 26,412 |
| | Contingencies | | | | 180,293 |
| | Total | | | | 1,081,000 |
| 14. | Recreational Facilities | | | | |
| | Handrail | 900 | LF | 10.23 | 9207 |
| | Walkway | 400 | CY | 144.48 | 57,792 |
| | Contingencies | | | | 14,001 |
| | Total | | | | 81,000 |
| 30. | Engineering and Design | | LS | | 726,000 |
| 31. | Supervision and Administration | | LS | | 161,000 |
| | Subtotal | | | | 2,800,000 |
| | Aids to Navigation | 2 | EA | 12,000 | 24,000 |
| | Total | | | | 2,824,000 |
| | Lands and Damages | | | | 135,000 |
| | Total | | | | 2,959,000 |

ENG FORM APR 67 1738 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

| REASONABLE CONTRACT ESTIMATE TABLE C5 (con't) | | | | | SHEET 2 OF 2 |
|---|---|---|---|---|---|
| PROJECT Geneva-on-the-Lake, OH Small Boat Harbor Alternative No. 4 Project Costs (May 1979 P.L.) | | | | | INVITATION NO. |
| ITEM NO. | DESCRIPTION | ESTIMATED QUANTITY | UNIT | UNIT PRICE | ESTIMATED AMOUNT |
| | Annual Maintenance | | | | |
| | Channels and Breakwaters | | LS | | 27,150 |
| | Aids to Navigation | | LS | | 850 |
| | Recreation | | LS | | 3,900 |
| | Total | | | | 31,900 |
| | Non-Federal Costs | | | | 1,535,000 |
| | 50% of Project Costs less Aids to Navigation | | | | (1,400,000) |
| | Cash Contribution for Navigation | | | | 1,350,000 |
| | Cash Contribution for Recreation | | | | 50,000 |
| | Lands and Damages | | | | (135,000) |
| | Federal Costs | | | | 1,424,000 |
| | 50% of Project Costs | | | | (1,400,000) |
| | Aids to Navigation | | | | (24,000) |

ENG FORM 1738 APR 67 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

Table C6 - Estimate of Annual Charges 1/
Alternative No. 1

| Item | Federal | Non-Federal 2/ | Total 2/ |
|---|---|---|---|
| | $ | $ | $ |
| First Cost | 2,019,000 | 2,116,000 | 4,135,000 |
| Interest During Construction | 138,800 | 145,500 | 284,300 |
| Total Investment Cost | 2,157,800 | 2,261,500 | 4,419,300 |
| | | | |
| Lands and Damages | 0 | 614,000 | 614,000 |
| Total Project Costs | 2,157,800 | 2,875,500 | 5,033,300 |
| | | | |
| Annual Charges | | | |
| Interest | 148,300 | 197,700 | 346,000 |
| Amortization | 5,500 | 7,400 | 12,900 |
| Maintenance | 39,400 | 5,000 | 44,400 |
| Total | 193,200 | 210,100 | 403,300 |

1/ Based on May 1979 price levels, 6-7/8 percent interest rate, and a 50-year economic life.

2/ Does not include self-liquidating cost for mooring area, launching ramps, and public service facilities currently estimated at $4,150,000 (May 1979 price levels).

*Table C7 - Estimate of Annual Charges* [1]
Alternative No. 2

| Item | Federal | Non-Federal [2] | Total [2] |
|---|---|---|---|
| | $ | $ | $ |
| First Cost | 2,098,000 | 2,050,000 | 4,148,000 |
| Interest During Construction | 144,200 | 140,900 | 285,100 |
| Total Investment Cost | 2,242,200 | 2,190,900 | 4,433,100 |
| | | | |
| Lands and Damages | 0 | 198,000 | 198,000 |
| Total Project Costs | 2,242,200 | 2,388,900 | 4,631,100 |
| | | | |
| Annual Charges | | | |
| Interest | 154,200 | 164,200 | 318,400 |
| Amortization | 5,800 | 6,100 | 11,900 |
| Maintenance | 36,200 | 8,200 | 44,400 |
| Total | 196,200 | 178,500 | 374,700 |

1/ Based on May 1979 price levels, 6-7/8 percent interest rate, and a 50-year economic life.

2/ Does not include self-liquidating cost for mooring area, launching ramps, and public service facilities currently estimated at $3,580,000 (May 1979 price levels).

Table C8 - Estimate of Annual Charges [1]
Alternative No. 3

| Item | Federal | Non-Federal [2] | Total [2] |
|---|---|---|---|
| | $ | $ | $ |
| First Cost | 1,599,000 | 1,575,000 | 3,174,000 |
| Interest During Construction | 109,900 | 108,200 | 218,100 |
| Total Investment Cost | 1,708,900 | 1,683,200 | 3,392,100 |
| | | | |
| Lands and Damages | 0 | 492,000 | 492,000 |
| Total Project Costs | 1,708,900 | 2,175,200 | 3,884,100 |
| | | | |
| Annual Charges | | | |
| Interest | 117,500 | 149,500 | 267,000 |
| Amortization | 4,400 | 5,600 | 10,000 |
| Maintenance | 29,200 | 4,500 | 33,700 |
| Total | 151,100 | 159,600 | 310,700 |

1/ Based on May 1979 price levels, 6-7/8 percent interest rate, and a 50-year economic life.

2/ Does not include self-liquidating cost for mooring area, launching ramps, and public service facilities currently estimated at $4,130,000 (May 1979 price levels).

Table C9 - Estimate of Annual Charges 1/
Alternative No. 4

| Item | Federal | Non-Federal 2/ | Total 2/ |
|---|---|---|---|
| | $ | $ | $ |
| First Cost | 1,424,000 | 1,400,000 | 2,824,000 |
| Interest During Construction | 97,900 | 96,300 | 194,200 |
| Total Investment Cost | 1,521,900 | 1,496,300 | 3,018,200 |
| | | | |
| Lands and Damages | 0 | 135,000 | 135,000 |
| Total Project Costs | 1,521,900 | 1,631,300 | 3,153,200 |
| | | | |
| Annual Charges | | | |
| Interest | 104,600 | 112,200 | 216,800 |
| Amortization | 3,900 | 4,200 | 8,100 |
| Maintenance | 28,000 | 3,900 | 31,900 |
| Total | 136,500 | 120,300 | 256,800 |

1/ Based on May 1979 price levels, 6-7/8 percent interest rate, and a 50-year economic life.

2/ Does not include self-liquidating cost for mooring area, launching ramps, and public service facilities currently estimated at $3,780,000 (May 1979 price levels).

APPENDIX D

ECONOMIC EVALUATION

GENEVA-ON-THE-LAKE SMALL-BOAT HARBOR

STAGE 2 REPORT
OF
REFORMULATION PHASE I GENERAL DESIGN MEMORANDUM

U. S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, NY 14207

AD-A102 194 CORPS OF ENGINEERS BUFFALO NY BUFFALO DISTRICT F/G 13/2
GENEVA-ON-THE-LAKE OHIO. SMALL BOAT HARBOR. STAGE 2 DOCUMENT FO--ETC(U)
APR 80 R AGUGLIA, J ZORICH, S GOLYSKI, J POPE

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GENEVA-ON-THE-LAKE, OH
GENERAL DESIGN MEMORANDUM
PHASE 1
STAGE 2 REPORT

APPENDIX D
ECONOMIC EVALUATION

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GENEVA-ON-THE-LAKE

ECONOMIC EVALUATION

INTRODUCTION

D1. The economic benefits resulting from the proposed project that are developed in the economics appendix are comprised of recreational benefits to boaters. Fishing benefits will not be analyzed in this report, but will be included in the Stage 3 report pending completion of a more definitive assessment of monetary benefits per activity occasion and fishing demand from the U.S. Fish and Wildlife Service. The end of this report will, however, provide a preliminary assessment of fishing demand and capacity. In order to calculate the benefits from recreational boating, it is necessary to forecast the demand for recreational boating.

METHODOLOGY FOR DEMAND FORECASTS

D2. The Ohio Department of Natural Resources has developed, in its 1975-80 Ohio State Comprehensive Outdoor Recreation Plan (SCORP), participation rates for eighteen recreation activities, including boating (power boating) and sailing. The participation rate is defined in SCORP (p. 56) as: "The number of times members of households participate in an outdoor recreation activity during a year. . ." Participation rates for each of the recreation activities were calculated as the weighted average of participation rates of as many as 35 socioeconomic variables and eight supply-accessibility variables. The weights were determined by the significance level for those variables having a level of significance equal to or less than 0.1 in a chi-square contingency table. A participation rate was calculated for each of 15 zones in the State of Ohio for each of the 18 recreation activities.

D3. The element of distance is taken into account by defining two origin zones. Zone 1 is comprised of Ashtabula County, in Ohio, which is the county of the proposed project. Zone 2 is broadly defined as the Cleveland, Akron, Youngstown-Warren SMSA's in Ohio, and the Erie SMSA in Pennsylvania.

D4. The regions for which participation rates where calculated in SCORP do not correspond perfectly with the SMSA's in the two origin zones defined in this study. Specifically, the participation rate used in this study for each of the SMSA's is the participation rate for the SCORP region containing the particular SMSA. To arrive at a single participation rate for Zone 2, the participation rates for

each of the SMSA's in Zone 2 were weighted by the proportion of the total population in Zone 2 accounted for by each of the Zone 2 SMSA's. The participation rate for the Ohio planning region adjacent to the Erie SMSA was used to represent the Erie SMSA area in Zone 2.

D5. SCORP provides participation rates for 1975, 1980, and 1990. A linear extrapolation, over time, was utilized to yield decadal participation rates for 1970 through 2030. These participation rates, together with projections of households for each of the origin zones, are the bases for forecasting boating demand.

D6. The construction of a steel mill at Conneaut, OH, will alter the socioeconomic variables impinging on the demand forecasts. Therefore, two scenarios are utilized in forecasting demand: Scenario 1, without the steel mill; and Scenario 2, taking the steel mill into account. Since the SCORP participation rates were calculated on the basis of socioeconomic variables not affected by the construction of a steel mill at Conneaut, OH, it was necessary to develop forecasts of recreational boating that recognized the impact of the steel mill while maintaining the same basic methodology contained in SCORP. This was accomplished by using multiple regression techniques. Specifically, it was found that regressing SCORP participation rates on projected values of number of households, population, income, household size, and leisure time, for each of the origin zones, yielded high and statistically significant correlation coefficients (as measured by the F statistic). Using projections by H. D. Little to take the impact of the steel mill into account for the above independent variables, a new set of participation rates were developed for Scenario 2. Table D1 provides the values for the socioeconomic variables for each of the two scenarios. Table D2 contains the participation rates for each of the two scenarios. Note that the participation rates for Scenario 1 are those projected from SCORP for 1975, 1980, and 1990, while the Scenario 2 participation rates were calculated from the multiple regression equations mentioned above.

Table D1 - Socio-Economic Variables

Scenario 1

| Zone | Population 1/ | | Households 1/ | | Income 2/ | | Household Size 3/ | | Leisure Time 4/ | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 |
| 1970 | 98.2 | 3,543.2 | 30.4 | 1,097.0 | 5.04 | 6.25 | 3.23 | 3.23 | 25.0 | 25.0 |
| 1980 | 111.2 | 3,779.1 | 37.8 | 1,285.4 | 7.86 | 8.13 | 2.94 | 2.94 | 27.0 | 27.0 |
| 1990 | 122.7 | 4,032.7 | 44.0 | 1,445.4 | 11.75 | 10.63 | 2.79 | 2.79 | 28.75 | 28.75 |
| 2000 | 132.6 | 4,202.5 | 49.7 | 1,573.9 | 15.78 | 13.97 | 2.67 | 2.67 | 30.6 | 30.6 |
| 2010 | 141.5 | 4,406.6 | 54.8 | 1,708.0 | 19.76 | 17.78 | 2.58 | 2.58 | 32.0 | 32.0 |
| 2020 | 148.4 | 4,533.9 | 59.1 | 1,806.3 | 23.90 | 22.76 | 2.51 | 2.51 | 33.0 | 33.0 |
| 2030 | 156.6 | 4,647.7 | 64.2 | 1,904.8 | 27.42 | 30.00 | 2.44 | 2.44 | 34.0 | 34.0 |

1/ In Thousands, Source: Ohio Dept. of Economic and Community Development, 1974. 2010-2030 are extrapolations of a trend.
2/ In Thousands of 1976 Dollars. Source: 1972 OBERS Projections adjusted for population differences.
3/ Source: Ohio State Dept. of Natural Resources, Ohio State Comprehensive Outdoor Recreation Plan, 1975. 2000-2030 are extrapolations of trends.
4/ Source: "Prospective Demand for Outdoor Recreation," Outdoor Recreation Resources Review Commission, 1962. 2010-2030 are extrapolations of trends.

Table D1 - Socio-Economic Variables (Cont'd)

Scenario 2

| Zone | Population 1/ | | Households 1/ | | Income 2/ | | Household Size | | Leisure Time 3/ | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 |
| 1970 | 98.2 | 3,543.2 | 30.4 | 1,097.0 | 5.04 | 6.25 | 3.23 | 3.23 | 25.0 | 25.0 |
| 1980 | 115.1 | 3,783.0 | 38.8 | 1,286.7 | 8.50 | 8.14 | 2.97 | 2.94 | 27.0 | 27.0 |
| 1990 | 132.7 | 4,038.7 | 46.7 | 1,447.6 | 11.90 | 10.64 | 2.84 | 2.79 | 28.75 | 28.75 |
| 2000 | 142.5 | 4,208.7 | 52.0 | 1,576.3 | 15.99 | 13.98 | 2.74 | 2.67 | 30.6 | 30.6 |
| 2010 | 152.1 | 4,413.1 | 57.4 | 1,710.5 | 20.02 | 17.80 | 2.65 | 2.58 | 32.0 | 32.0 |
| 2020 | 159.3 | 4,540.6 | 62.2 | 1,801.8 | 24.21 | 22.78 | 2.56 | 2.52 | 33.0 | 33.0 |
| 2030 | 168.3 | 4,654.6 | 68.4 | 1,899.8 | 27.78 | 30.30 | 2.46 | 2.45 | 34.0 | 34.0 |

1/ In Thousands
2/ In Thousands of 1976 Dollars
3/ In Hours per Week

Source: Population, Household, and Income series are based on I. M. Little projections contained in the Draft Environmental Impact Statement, U. S. Army Corps of Engineer District, Buffalo, Vol. 3, 1978. Household size was computed by dividing Population by Households. Leisure Time is the same series used in Scenario 1.

D7. Participation rates, by scenario:

Table D2 - Participation Rates

Scenario 1

| | Powerboating | | Sailing | | Fishing | |
|---|---|---|---|---|---|---|
| | Zone 1 | Zone 2 | Zone 1 | Zone 2 | Zone 1 | Zone 2 |
| 1970 | 3.01 | 3.032 | .380 | .401 | 4.964 | 4.969 |
| 1980 | 2.98 | 3.007 | .385 | .410 | 4.958 | 4.963 |
| 1990 | 2.946 | 2.982 | .393 | .423 | 4.952 | 4.957 |
| 2000 | 2.91 | 2.956 | .400 | .438 | 4.946 | 4.952 |
| 2010 | 2.88 | 2.939 | .410 | .450 | 4.941 | 4.946 |
| 2020 | 2.84 | 2.911 | .420 | .467 | 4.937 | 4.940 |
| 2030 | 2.81 | 2.883 | .430 | .477 | 4.934 | 4.939 |

Scenario 2

| | Powerboating | | Sailing | | Fishing | |
|---|---|---|---|---|---|---|
| | Zone 1 | Zone 2 | Zone 1 | Zone 2 | Zone 1 | Zone 2 |
| 1970 | 3.02 | 3.03 | .380 | .401 | 4.960 | 4.970 |
| 1980 | 3.05 | 3.01 | .388 | .410 | 4.931 | 4.959 |
| 1990 | 3.00 | 2.98 | .398 | .423 | 4.892 | 4.960 |
| 2000 | 2.97 | 2.95 | .406 | .437 | 4.881 | 4.951 |
| 2010 | 2.93 | 2.88 | .416 | .452 | 4.879 | 4.947 |
| 2020 | 2.89 | 2.86 | .426 | .463 | 4.876 | 4.947 |
| 2030 | 2.85 | 2.85 | .437 | .476 | 4.875 | 4.945 |

D8. Participation rates multiplied by total households will equal annual peak-day activity occasions. Divide by the number of annual peak-days (24 - boating, 27 - sailing, 38 - fishing), to arrive at peak-day recreationists, by activity. This is shown for the two scenarios (in thousands):

Table D3 - Number of Recreationists per Peak-Day, from Origin-Zone

Scenario 1

| | Powerboating | | Sailing | | Fishing | |
|---|---|---|---|---|---|---|
| | Zone 1 | Zone 2 | Zone 1 | Zone 2 | Zone 1 | Zone 2 |
| 1970 | 3.81 | 138.59 | .43 | 16.29 | 12.83 | 463.33 |
| 1980 | 4.69 | 161.05 | .54 | 19.51 | 14.50 | 493.97 |
| 1990 | 5.41 | 179.59 | .64 | 22.64 | 16.00 | 526.05 |
| 2000 | 6.03 | 193.85 | .74 | 25.53 | 17.27 | 547.63 |
| 2010 | 6.58 | 209.16 | .83 | 29.54 | 18.38 | 573.56 |
| 2020 | 6.99 | 219.09 | .92 | 31.24 | 19.27 | 589.40 |
| 2030 | 7.51 | 228.81 | 1.02 | 33.65 | 20.34 | 604.08 |

Scenario 2

| | Powerboating | | Sailing | | Fishing | |
|---|---|---|---|---|---|---|
| | Zone 1 | Zone 2 | Zone 1 | Zone 2 | Zone 1 | Zone 2 |
| 1970 | 3.83 | 138.50 | .43 | 16.29 | 3.97 | 143.4 |
| 1980 | 4.93 | 161.37 | .56 | 19.54 | 5.03 | 167.91 |
| 1990 | 5.84 | 179.74 | .69 | 22.68 | 6.01 | 188.95 |
| 2000 | 6.43 | 191.88 | .78 | 25.51 | 6.68 | 205.38 |
| 2010 | 7.01 | 205.26 | .88 | 28.63 | 7.37 | 222.68 |
| 2020 | 7.49 | 214.71 | .98 | 30.90 | 7.98 | 234.57 |
| 2030 | 8.12 | 225.60 | 1.11 | 33.49 | 8.78 | 247.22 |

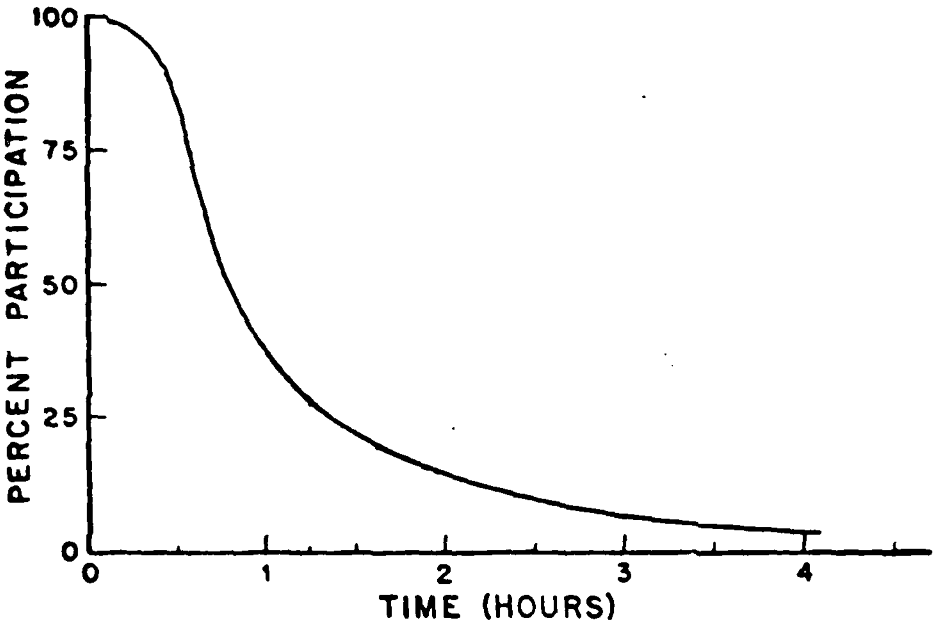
D9. Fishing will be evaluated separately, beginning in paragraph 32. The boaters (defined as powerboaters and sailors) are identified by origin-zone. The next step is to identify what portion of the boaters entering the boating market will be attracted to Ashtabula County. Two parameters are studied: travel time and alternate site competition.

a. Travel Time - All boaters originating in Ashtabula County are estimated to be one-half hour in travel time from their boating source. New York State's Travel Time - Percent Participation Curve is consulted (Figure D1). Since Ohio and New York are both highly populated, industrial, northeast States, their populations are likely to exhibit similar recreation preferences. The curve shows that 91.75 percent of the boaters are willing to travel one-half hour for the activity. The projected boaters for Zone 1 are reduced for both scenarios to account for in-county demand. Zone 2 boaters are assumed to have a population centroid one and one-half hours of travel time from Ashtabula County. The percent willing to travel this distance is 22.95 percent.

b. Alternate Site - By definition, boating in Ashtabula County is one one-half hour from boaters originating in the county. Therefore, the alternate site factor for Zone 1 is 1.000. ODNR in the 1975 SCORP identified county capacities for boating in terms of acres. Ashtabula has 3,732 acres of boating. This is not explicitly stated in SCORP. However, by totalling the inland acreage, it appears that the Lake Erie counties are allocated 1,000 acres. The total of Ohio counties within the expected travel time, plus Erie and Crawford, PA, and Chautauqua County, NY, (Erie and Crawford are estimated from like counties in Ohio, Chautauqua is from NY-SCORP) have 34,564 acres of boating capacity. Ashtabula County's portion is 10.8 percent, so the alternate site factor for Zone 2 boaters is .108. By applying travel time and alternate site factors, the number of peak-day boaters in Ashtabula County is found for each year.

Multiplying the number of peak-day boaters in Table D3 by the travel-time and alternate site factor appropriate to each zone yields Peak Day Boaters in Ashtabula County (Table D4).

FIGURE D1




BOATING TRAVEL TIME DECAY CURVE

SOURCE: N.Y.S. PARKS AND RECREATION DEPT.; COMPREHENSIVE RECREATION PLAN, 1972.

Table D4 - Peak-Day Boaters in Ashtabula County
(In Thousands)

Scenario 1

| | Powerboaters | | Sailors | |
|---|---|---|---|---|
| | Zone 1 | Zone 2 | Zone 1 | Zone 2 |
| 1970 | 3.50 | 3.43 | .39 | .55 |
| 1980 | 4.30 | 3.99 | .49 | .66 |
| 1990 | 5.00 | 4.45 | .59 | .76 |
| 2000 | 5.50 | 4.80 | .68 | .86 |
| 2010 | 6.00 | 5.18 | .76 | 1.00 |
| 2020 | 6.40 | 5.43 | .84 | 1.05 |
| 2030 | 6.90 | 5.67 | .94 | 1.14 |

Scenario 2

| | Powerboaters | | Sailors | |
|---|---|---|---|---|
| | Zone 1 | Zone 2 | Zone 1 | Zone 2 |
| 1970 | 3.51 | 3.43 | .39 | .55 |
| 1980 | 4.52 | 4.00 | .51 | .66 |
| 1990 | 5.36 | 4.46 | .63 | .77 |
| 2000 | 5.90 | 4.80 | .72 | .86 |
| 2010 | 6.43 | 5.09 | .81 | .97 |
| 2020 | 6.87 | 5.32 | .90 | 1.04 |
| 2030 | 7.45 | 5.59 | 1.01 | 1.13 |

D10. The participants are correlated to boats. Ohio SCORP estimates 2.5 persons/boat. New York, Michigan, and Pennsylvania estimate from 2.2 to 2.5. In this instance, 2.46 persons per boat from a weighted average is used. The peak-day boaters are divided by this number to arrive at the number of boats.

D11. The next step is to determine what boats in use would be permanently kept in moorings and berths, and what boats would be trailered. This is accomplished by associating trailerings to the small-boat sizes. ODNR boater registration statistics show that 66.7 percent of all sailboats and 57.8 percent of all power boats are 16 feet or less in length. Ninety percent of these are estimated to be trailered. Therefore, multiplying number of peak-day boats by [(.578) (.90)], for power boats, and [(.667) (.90)], for sailboats, yields trailered power boats and trailered sailboats. Subtracting the number of trailered boats in each category from the number of peak-day boats in the corresponding category yields permanent boats, in each category. Table D5 provides the results of these calculations for both scenarios.

Table D5 - Permanent and Trailered Boats in Ashtabula County per Peak Day
(In Thousands)

Scenario 1

| | Powerboats | | | | Sailboats | | | |
|---|---|---|---|---|---|---|---|---|
| | Zone 1 | | Zone 2 | | Zone 1 | | Zone 2 | |
| | Permanent | Trailered | Permanent | Trailered | Permanent | Trailered | Permanent | Trailered |
| 1970 | .67 | .78 | .67 | .72 | .06 | .10 | .09 | .13 |
| 1980 | .82 | .88 | .78 | .84 | .08 | .12 | .11 | .16 |
| 1990 | .96 | 1.04 | .87 | .94 | .10 | .14 | .12 | .19 |
| 2000 | 1.06 | 1.14 | .94 | 1.01 | .11 | .17 | .14 | .21 |
| 2010 | 1.15 | 1.25 | 1.01 | 1.10 | .12 | .19 | .16 | .24 |
| 2020 | 1.25 | 1.35 | 1.06 | 1.15 | .14 | .21 | .17 | .26 |
| 2030 | 1.34 | 1.46 | 1.10 | 1.20 | .15 | .23 | .18 | .28 |

Table D5 - Permanent and Trailered Boats in Ashtabula County per Peak Day (Cont'd)
(In Thousands)

Scenario 2

| | Powerboats | | | | Sailboats | | | |
|---|---|---|---|---|---|---|---|---|
| | Zone 1 | | Zone 2 | | Zone 1 | | Zone 2 | |
| | Permanent | Trailered | Permanent | Trailered | Permanent | Trailered | Permanent | Trailered |
| 1970 | .69 | .74 | .67 | .72 | .06 | .10 | .09 | .13 |
| 1980 | .88 | .96 | .78 | .85 | .08 | .13 | .11 | .16 |
| 1990 | 1.05 | 1.13 | .87 | .94 | .10 | .15 | .12 | .19 |
| 2000 | 1.15 | 1.25 | .94 | 1.01 | .12 | .18 | .14 | .21 |
| 2010 | 1.25 | 1.36 | .99 | 1.08 | .13 | .20 | .16 | .24 |
| 2020 | 1.34 | 1.45 | 1.04 | 1.12 | .15 | .22 | .17 | .26 |
| 2030 | 1.45 | 1.58 | 1.09 | 1.18 | .17 | .25 | .18 | .28 |

## DEMAND FORECASTS - BOATING

D12. The final step in allocating boating demand to Ashtabula County's Lake Erie shoreline is a comparison of facility location within the county. Lake Erie facilities are 800 moorings and 14 launch ramps. Inland facilities (Pymatuning Reservoir) have 500 moorings and 10 launch ramps. The boating activities have Lake Erie as the source for sailing. Therefore, 85 percent of the permanent sailboats and 84 percent of the trailered sailboats will be attracted to Lake Erie facilities. Powered boats will have 60 percent of the permanent and 54 percent of the trailered going to Lake Erie. The relationships are based on the proportion of facilities in the county and the activities likely at Lake Erie or the reservoir. Table D6 provides the allocation of boats on Lake Erie on Ashtabula County's shoreline.

Table D6 - Demand on Lake Erie Based on Distribution of Facilities and Distribution of Demand

Scenario 1

| | Power Boats | | | | | | Sailboats | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Permanent | | | Trailered | | | Permanent | | | Trailered | | |
| | 1 | 2 | Total | 1 | 2 | Total | 1 | 2 | Total | 1 | 2 | Total |
| 1970 | .40 | .40 | .80 | .73 | .72 | 1.45 | .05 | .08 | .13 | .10 | .13 | .23 |
| 1980 | .49 | .47 | .96 | .88 | .84 | 1.72 | .06 | .09 | .15 | .12 | .16 | .28 |
| 1990 | .58 | .52 | 1.10 | 1.04 | .94 | 1.98 | .08 | .11 | .19 | .14 | .19 | .33 |
| 2000 | .64 | .56 | 1.20 | 1.14 | 1.01 | 2.15 | .09 | .12 | .21 | .17 | .21 | .39 |
| 2010 | .69 | .61 | 1.30 | 1.25 | 1.10 | 2.35 | .11 | .14 | .25 | .19 | .24 | .43 |
| 2020 | .75 | .64 | 1.39 | 1.35 | 1.15 | 2.50 | .12 | .15 | .27 | .21 | .26 | .47 |
| 2030 | .80 | .66 | 1.46 | 1.46 | 1.20 | 2.66 | .13 | .16 | .29 | .23 | .28 | .51 |

Table D6 - Demand on Lake Erie Based on Distribution of Facilities and Distribution of Demand (Cont'd)

Scenario 2

| | Power Boats | | | | | | Sailboats | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Permanent | | | Trailered | | | Permanent | | | Trailered | | |
| | 1 | 2 | Total | 1 | 2 | Total | 1 | 2 | Total | 1 | 2 | Total |
| 1970 | .41 | .40 | .81 | .74 | .72 | 1.46 | .05 | .08 | .13 | .08 | .11 | .19 |
| 1980 | .53 | .47 | 1.00 | .96 | .85 | 1.81 | .07 | .09 | .16 | .11 | .14 | .25 |
| 1990 | .63 | .52 | 1.15 | 1.13 | .94 | 2.07 | .09 | .10 | .19 | .13 | .16 | .29 |
| 2000 | .69 | .56 | 1.25 | 1.25 | 1.01 | 2.26 | .10 | .12 | .22 | .15 | .18 | .33 |
| 2010 | .75 | .59 | 1.34 | 1.36 | 1.08 | 2.44 | .11 | .14 | .25 | .17 | .20 | .37 |
| 2020 | .80 | .62 | 1.42 | 1.45 | 1.12 | 2.57 | .12 | .14 | .26 | .18 | .22 | .40 |
| 2030 | .87 | .65 | 1.52 | 1.58 | 1.18 | 2.76 | .14 | .15 | .29 | .21 | .23 | .43 |

D13. At this point, we can combine the zones to arrive at total demand for permanent moorings on the Lake Erie coast in Ashtabula County (Table D7). Trailered boats will be discussed later.

Table D7 - Demand for Permanent Moorings on Lake Erie
(In Thousands)

Scenario 1

| | Power | | | Sail | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | Total | 1 | 2 | Total | 1 | 2 | Total |
| 1970 | .40 | .40 | .80 | .05 | .08 | .13 | .45 | .48 | .93 |
| 1980 | .49 | .47 | .96 | .06 | .09 | .15 | .55 | .56 | 1.11 |
| 1990 | .58 | .52 | 1.10 | .08 | .11 | .19 | .66 | .63 | 1.29 |
| 2000 | .64 | .56 | 1.20 | .09 | .12 | .21 | .73 | .68 | 1.41 |
| 2010 | .69 | .61 | 1.30 | .11 | .14 | .25 | .80 | .75 | 1.55 |
| 2020 | .75 | .64 | 1.39 | .12 | .15 | .27 | .87 | .79 | 1.66 |
| 2030 | .80 | .66 | 1.46 | .13 | .16 | .29 | .93 | .82 | 1.75 |

Scenario 2

| | Power | | | Sail | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | Total | 1 | 2 | Total | 1 | 2 | Total |
| 1970 | .41 | .40 | .81 | .05 | .08 | .13 | .45 | .48 | .93 |
| 1980 | .53 | .47 | 1.00 | .07 | .09 | .16 | .60 | .56 | 1.16 |
| 1990 | .63 | .52 | 1.15 | .09 | .10 | .19 | .72 | .62 | 1.34 |
| 2000 | .69 | .56 | 1 25 | .10 | .12 | .22 | .79 | .68 | 1.47 |
| 2010 | .75 | .59 | 1.34 | .11 | .14 | .25 | .86 | .73 | 1.59 |
| 2020 | .80 | .62 | 1.42 | .12 | .14 | .26 | .92 | .76 | 1.68 |
| 2030 | .87 | .65 | 1.52 | .14 | .15 | .29 | 1.01 | .80 | 1.81 |

D14. By 1990, demand for moorings with Scenario 1 is 1,290, while Scenario 2 is 1,340. The increase of 50 moorings demanded is due to the influx of people and income into Ashtabula County due to the construction of the proposed steel mill.

## FLEET MIX FOR ALLOCATION OF DEMAND

D15. The demand projections in Tables D6 and D7 provide a division of demand between power boats and sailboats. Calculation of benefits will require, however, that the projected demand be delineated further in terms of a fleet mix -- type and size of craft within each category. An examination of data for the fleet mix at Ashtabula and Fairport Harbors, and data contained in the Great Lakes Framework Commission Study, provided a basis for constructing a fleet mix at the present mooring capacity of 800 boats. This probable fleet mix is presented in Table D8. The proportion that each boat type and boat length is of the total number in its respective boat category (power vs. sail) will be the basis for determining the fleet mix in the demand projections. The analysis of economic efficiency will be based on a 400-berth facility. Monetary benefits for a 600-berth facility will be calculated in this report for purposes of sensitivity analysis of benefits.

Table D8 - Present Fleet Characteristics

| OB 16 | OB 16-25 | IB 16-25 | C 16-25 | C 26-39 | C 40-64 | Total Power | S 16 | S 16-25 | AS 16-25 | AS 26-39 | AS 40-64 | Total Sail | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 56 | 24 | 104 | 54 | 364 | 61 | 663 | 11 | 11 | 13 | 89 | 13 | 137 | 800 |

OB - Outboard
IB - Inboard
C - Cruiser
S - Sailboat
AS - Auxiliary Sailboat

D16. Table D7 indicates that the demand for permanent moorings will reach 1,290 by 1990. Since the total capacity created by the 400-berth facility will be for 1,200 moorings, it is apparent that demand for moorings will, ignoring the excess of 90 moorings, equal supply. Therefore, the percent of power boats (85 percent) and sailboats (15 percent) in 1990 will be the basis for fleet mix between power boats and sailboats.

## CALCULATION OF BENEFITS FOR PERMANENT MOORINGS - SCENARIO 1

D17. The fleet split from paragraph D15 and the fleet mix proportions from Table D8 yield the fleet-in-use at Geneva for the 400-berth facility specified in Table D9. It is assumed that four berths will be utilized by transients.

Table D9 - Fleet in Use at Geneva

| OB 16 | OB 16-25 | IB 16-25 | C 16-25 | C 26-39 | C 40-64 | Total Power | Transient | Total Mooring |
|---|---|---|---|---|---|---|---|---|
| 29 | 12 | 53 | 27 | 185 | 31 | 337 | 4 | 400 |
| S 16 | S 16-25 | AS 16-25 | AS 26-39 | AS 40-64 | | Total Sail | | |
| 5 | 5 | 6 | 37 | 6 | | 59 | | |

It is assumed that 25 percent of the boats used at this facility will be expected to transfer from other sites in the vicinity. Transfers are expected to be in cruisers and auxiliary sailboats. The moorings vacated by these transfers will be used, in turn, by new boats and transferred boats that are distributed to reflect the demand for boats described in paragraph D12. The distribution of power and sailboats utilizing vacant moorings is expected to be similar to the fleet in use in 1970, within the respective power-sail category. Once again, 75 percent of the boats utilizing vacated moorings are expected to be new, and 25 percent transferred.

Four fleets are developed for benefit calculations, new boats at Geneva, transferred boats at Geneva, new boats at vacated moorings, and transferred boats at vacated moorings. Due to Geneva's location along Lake Erie, the rates of return used in the benefit calculations for the Geneva site are assumed to be the maximum regional rates of return. In addition, it is assumed that in order for a boat to transfer, a gain of 10 percent in its rate of return is necessary. Average depreciated values are derived from ABOS 1978 Retail Boat Prices. Since the prices from this source are 1977 values, they are

updated by gains in the reading and recreation index component of the consumer price index. The average depreciated values are one-half the total retail price of a new boat of the type and size. The benefit calculations are shown for the 400-boat facility, Scenario 1 in Tables D10 through D13.

The fleet use for the 600-berth facility will be the same as the 400-berth facility in terms of the proportions for fleet split and fleet mix. One percent of its capacity (six berths) will be used for transients. The capacity of the 600-berth facility will not be fully utilized, however, until about the year 2000, when the demand for total capacity (800 existing berths, plus 600 new berths) is expected to be 1,510. The same rates of return, distribution of transfers and new boats, and depreciated values, are used to calculate the benefits shown in Tables D14 through D17.

The tables also show the effect of growth rates. An 8-year (1982-1990) normal growth rate for the 400-berth facility and a 20-year straight-line growth rate (1980-2000) for the 600-berth facility, are used for a 50-year project life to show the average annual effect on the improvements. At 6-7/8 percent interest, this factor equals .7906 for the 400-berth facility and .5391 for the 600-berth facility.

Table D10 - New Boats at 400-Berth Facility at Geneva-on-the-Lake

Scenario 1

| Type | Class. | Size | Number of Boats | Average Depreciated Value | Rates of Return | | | | Gain | Value | On Cruise | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Ideal | Max. | Pres. | Future | | | Average Days Use | Average Days on Cruise | Percent Use | Value |
| | | (feet) | | $ | | | | | | $ | | | | $ |
| Outboard | | Less Than 16 | 29 | 1,183 | 15 | 13 | - | 13 | 13 | 4,460 | | | | |
| Outboard | | 16-25 | 12 | 3,450 | 15 | 13 | - | 13 | 13 | 5,382 | | | | |
| Inboard | | 16-25 | 53 | 6,851 | 12 | 10.5 | - | 10.5 | 10.5 | 38,126 | | | | |
| Cruiser | | 16-25 | 18 | 7,178 | 9 | 8 | - | 8 | 8 | 10,336 | | | | |
| Cruiser | | 26-39 | 123 | 26,869 | 9 | 8 | - | 8 | 8 | 264,391 | 42 | 3 | 7.1 | 18,772 |
| Cruiser | | 40-64 | 20 | 96,182 | 9 | 8 | - | 8 | 8 | 153,891 | 42 | 7 | 16.7 | 25,700 |
| Sailboat | | Less Than 16 | 5 | 834 | 12 | 10.5 | - | 10.5 | 10.5 | 438 | | | | |
| Sailboat | | 16-25 | 5 | 4,382 | 12 | 10.5 | - | 10.5 | 10.5 | 2,301 | | | | |
| Auxiliary Sailboat | | 16-25 | 4 | 10,327 | 9 | 8 | - | 8 | 8 | 3,305 | | | | |
| Auxiliary Sailboat | | 26-39 | 24 | 22,296 | 9 | 8 | - | 8 | 8 | 42,808 | 42 | 3 | 7.1 | 3,039 |
| Auxiliary Sailboat | | 40-64 | 4 | 52,729 | 9 | 8 | - | 8 | 8 | 16,873 | 42 | 7 | 16.7 | 2,818 |
| Total | | | 297 | | | | | | | 542,311 | | | | 50,329 |

Table D11 - Transferred Boats at 400-Berth Facility at Geneva-on-the-Lake

Scenario 1

| Type | Class. | Size | Number of Boats | Average Depreciated Value | Rates of Return | | | | Gain | Value | On Cruise | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Ideal | Max. | Pres. | Future | | | Average Days Use | Average Days on Cruise | Percent Use | Value |
| | | (feet) | | $ | | | | | | $ | | | | $ |
| Cruiser | | 16-25 | 9 | ?,178 | 9 | 8 | 7.2 | 8 | .8 | 517 | | | | |
| Cruiser | | 26-39 | 62 | 26,869 | 9 | 8 | 7.2 | 8 | .8 | 13,327 | 42 | 3 | 7.1 | 946 |
| Cruiser | | 40-64 | 11 | 96,182 | 9 | 8 | 7.2 | 8 | .8 | 8,464 | 42 | 7 | 16.7 | 1,413 |
| Auxiliary Sailboat | | 16-25 | 2 | 10,328 | 9 | 8 | 7.2 | 8 | .8 | 1[illegible] | | | | |
| Auxiliary Sailboat | | 26-39 | 13 | 22,296 | 9 | 8 | 7.2 | 8 | .8 | 2,319 | 42 | 3 | 7.1 | 165 |
| Auxiliary Sailboat | | 40-64 | 2 | 52,729 | 9 | 8 | 7.2 | 8 | .8 | 843 | 42 | 7 | 16.7 | 141 |
| Total | | | 99 | | | | | | | 25,635 | | | | 2,665 |

Table D12 - New Boats Utilizing Vacated Moorings Due to 400-Boat Marina at Geneva

Scenario 1

| Type | Class. | Size | Number of Boats | Average Depreciated Value | Rates of Return | | | | Gain | Value | On Cruise | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Ideal | Max. | Pres. | Future | | | Average Days Use | Average Days on Cruise | Percent Use | Value |
| | | (feet) | | $ | | | | | | $ | | | | $ |
| Outboard | | Less Than 16 | 5 | 1,183 | 15 | 13 | - | 11.8 | 11.8 | 698 | | | | |
| Outboard | | 16-25 | 2 | 3,450 | 15 | 13 | - | 11.8 | 11.8 | 814 | | | | |
| Inboard | | 16-25 | 10 | 6,851 | 12 | 10.5 | - | 9.5 | 9.5 | 6,508 | | | | |
| Cruiser | | 16-25 | 5 | 7,178 | 10 | 8 | - | 7.2 | 7.2 | 2,584 | | | | |
| Cruiser | | 26-39 | 36 | 26,869 | 9 | 8 | - | 7.2 | 7.2 | 69,643 | 42 | 3 | 7.1 | 4,944 |
| Cruiser | | 40-64 | 7 | 96,182 | 9 | 8 | - | 7.2 | 7.2 | 48,476 | 42 | 7 | 16.7 | 8,095 |
| Sailboat | | Less Than 16 | 1 | 834 | 12 | 10.5 | - | 9.5 | 9.5 | 80 | | | | |
| Sailboat | | 16-25 | 1 | 4,382 | 12 | 10.5 | - | 9.5 | 9.5 | 416 | | | | |
| Auxiliary Sailboat | | 16-25 | 1 | 10,328 | 9 | 8 | - | 7.2 | 7.2 | 743 | | | | |
| Auxiliary Sailboat | | 26-39 | 5 | 22,296 | 9 | 8 | - | 7.2 | 7.2 | 8,027 | 42 | 3 | 7.1 | 570 |
| Auxiliary Sailboat | | 40-64 | 1 | 52,729 | 9 | 8 | - | 7.2 | 7.2 | 3,796 | 42 | 7 | 16.7 | 634 |
| Total | | | 74 | | | | | | | 141,785 | | | | 14,243 |

Table D13 - Transfer Boats Utilizing Vacated Moorings Due to 400-Boat Marina at Geneva

Scenario 1

| Type | Class. | Size | Number of Boats | Average Depreciated Value | Rates of Return | | | | Gain | Value | On Cruise | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Ideal | Max. | Pres. | Future | | | Average Days Use | Average Days on Cruise | Percent Use | Value |
| | | (feet) | | $ | | | | | | $ | | | | $ |
| Outboard | | Less Than 16 | 2 | 1,183 | 15 | 13 | 10.7 | 11.8 | 1.1 | 26 | | | | |
| Outboard | | 16-25 | 1 | 3,450 | 15 | 13 | 10.7 | 11.8 | 1.1 | 38 | | | | |
| Inboard | | 16-25 | 3 | 6,851 | 12 | 10.5 | 8.6 | 9.5 | .9 | 185 | | | | |
| Cruiser | | 16-25 | 2 | 7,178 | 9 | 8 | 6.5 | 7.2 | .7 | 100 | | | | |
| Cruiser | | 26-39 | 11 | 26,869 | 9 | 8 | 6.5 | 7.2 | .7 | 2,069 | 42 | 3 | 7.1 | 147 |
| Cruiser | | 40-64 | 2 | 96,182 | 9 | 8 | 6.5 | 7.2 | .7 | 1,346 | 42 | 7 | 16.7 | 225 |
| Sailboat | | Less Than 16 | - | - | - | - | - | - | | | | | | |
| Sailboat | | 16-25 | - | - | - | - | - | - | | | | | | |
| Auxiliary Sailboat | | 16-25 | 1 | 10,328 | 9 | 8 | 6.5 | 7.2 | .7 | 72 | | | | |
| Auxiliary Sailboat | | 26-39 | 2 | 22,296 | 9 | 8 | 6.5 | 7.2 | .7 | 312 | 42 | 3 | 7.1 | 22 |
| Auxiliary Sailboat | | 40-64 | 1 | 52,729 | 9 | 8 | 6.5 | 7.2 | .7 | 370 | 42 | 7 | 16.7 | 62 |
| Total | | | 25 | | | | | | | 4,518 | | | | 456 |

Table D14 - New Boats at 600-Berth Facility at Geneva-on-the-Lake

Scenario 1

| Type | Class. | Size | Number of Boats | Average Depreciated Value | Rates of Return | | | | Gain | Value | On Cruise | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Ideal | Max. | Pres. | Future | | | Average Days Use | Average Days on Cruise | Percent Use | Value |
| | | (feet) | | $ | | | | | | $ | | | | $ |
| Outboard | | Less Than 16 | 42 | 1,183 | 15 | 13 | - | 13 | 13 | 6,459 | | | | |
| Outboard | | 16-25 | 18 | 3,450 | 15 | 13 | - | 13 | 13 | 8,073 | | | | |
| Inboard | | 16-25 | 112 | 6,851 | 12 | 10.5 | - | 10.5 | 10.5 | 56,829 | | | | |
| Cruiser | | 16-25 | 28 | 7,178 | 9 | 8 | - | 8 | 8 | 16,079 | | | | |
| Cruiser | | 26-39 | 129 | 26,869 | 9 | 8 | - | 8 | 8 | 393,362 | 42 | 3 | 7.1 | 27,928 |
| Cruiser | | 40-64 | 21 | 96,182 | 9 | 8 | - | 8 | 8 | 230,837 | 42 | 7 | 16.7 | 38,550 |
| Sailboat | | Less Than 16 | 7 | 834 | 12 | 10.5 | - | 10.5 | 10.5 | 613 | | | | |
| Sailboat | | 16-25 | 8 | 4,382 | 12 | 10.5 | - | 10.5 | 10.5 | 3,681 | | | | |
| Auxiliary Sailboat | | 16-25 | 7 | 10,328 | 9 | 8 | - | 8 | 8 | 5,784 | | | | |
| Auxiliary Sailboat | | 26-39 | 38 | 22,296 | 9 | 8 | - | 8 | 8 | 67,780 | 42 | 3 | 7.1 | 4,812 |
| Auxiliary Sailboat | | 40-64 | 5 | 52,728 | 9 | 8 | - | 8 | 8 | 21,091 | 42 | 7 | 16.7 | 3,522 |
| Total | | | 445 | | | | | | | 810,588 | | | | 74,812 |

Table D15 - Transferred Boats at 600-Mooring Facility at Geneva-on-the-Lake

Scenario 1

| Type | Class. | Size | Number of Boats | Average Depreciated Value | Rates of Return | | | | Gain | Value | On Cruise | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Ideal | Max. | Pres. | Future | | | Average Days Use | Average Days on Cruise | Percent Use | Value |
| | | (feet) | | $ | | | | | | $ | | | | $ |
| Cruiser | | 16-25 | 14 | 7,178 | 9 | 8 | 7.2 | 8 | .8 | 804 | | | | |
| Cruiser | | 26-39 | 94 | 26,869 | 9 | 8 | 7.2 | 8 | .8 | 20,205 | 42 | 3 | 7.1 | 1,436 |
| Cruiser | | 40-64 | 16 | 96,182 | 9 | 8 | 7.2 | 8 | .8 | 12,311 | 42 | 7 | 16.7 | 2,056 |
| Auxiliary Sailboat | | 16-25 | 3 | 10,328 | 9 | 8 | 7.2 | 8 | .8 | 248 | | | | |
| Auxiliary Sailboat | | 26-39 | 20 | 22,296 | 9 | 8 | 7.2 | 8 | .8 | 3,567 | 42 | 3 | 7.1 | 253 |
| Auxiliary Sailboat | | 40-64 | 2 | 52,729 | 9 | 8 | 7.2 | 8 | .8 | 843 | 42 | 7 | 16.7 | 141 |
| Total | | | 149 | | | | | | | 37,978 | | | | 3,886 |

Table D16 - New Boats Utilizing Vacated Moorings for 600-Berth Facility at Geneva

Scenario 1

| Type | Class. | Size | Number of Boats | Average Depreciated Value | Rates of Return | | | | Gain | Value | On Cruise | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Ideal | Max. | Pres. | Future | | | Average Days Use | Average Days on Cruise | Percent Use | Value |
| | | (feet) | | $ | | | | | | $ | | | | $ |
| Outboard | | Less Than 16 | 8 | 1,183 | 15 | 13 | - | 11.8 | 11.8 | 922 | | | | |
| Outboard | | 16-25 | 3 | 3,449 | 15 | 13 | - | 11.8 | 11.8 | 1,221 | | | | |
| Inboard | | 16-25 | 15 | 6,851 | 12 | 10.5 | - | 9.5 | 9.5 | 9,763 | | | | |
| Cruiser | | 16-25 | 8 | 7,178 | 9 | 8 | - | 7.2 | 7.2 | 4,135 | | | | |
| Cruiser | | 26-39 | 52 | 26,869 | 9 | 8 | - | 7.2 | 7.2 | 100,598 | 42 | 3 | 7.1 | 7,142 |
| Cruiser | | 40-64 | 9 | 96,182 | 9 | 8 | - | 7.2 | 7.2 | 62,326 | 42 | 7 | 16.7 | 10,408 |
| Sailboat | | Less Than 16 | 1 | 834 | 12 | 10.5 | - | 9.5 | 9.5 | 79 | | | | |
| Sailboat | | 16-25 | 1 | 4,382 | 12 | 10.5 | - | 9.5 | 9.5 | 416 | | | | |
| Auxiliary Sailboat | | 16-25 | 2 | 10,328 | 9 | 8 | - | 7.2 | 7.2 | 1 487 | | | | |
| Auxiliary Sailboat | | 26-39 | 11 | 22,296 | 9 | 8 | - | 7.2 | 7.2 | 17,658 | 42 | 3 | 7.1 | 1,254 |
| Auxiliary Sailboat | | 40-64 | 2 | 52,729 | 9 | 8 | - | 7.2 | 7.2 | 7,593 | 42 | 7 | 16.7 | 1 268 |
| Total | | | 112 | | | | | | | 206,198 | | | | 20,072 |

Table D17 - Transferred Boats at Vacated Facilities with 600-Berth Facility at Geneva

Scenario 1

| Type | Class. | Size | Number of Boats | Average Depreciated Value | Rates of Return | | | | Gain | Value | On Cruise | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Ideal | Max. | Pres. | Future | | | Average Days Use | Average Days on Cruise | Percent Use | Value |
| | | (feet) | | $ | | | | | | $ | | | | $ |
| Outboard | | Less Than 16 | 3 | 1,183 | 15 | 13 | 10.7 | 11.8 | 1.1 | 39 | | | | |
| Outboard | | 16-25 | 1 | 3,450 | 15 | 13 | 10.7 | 11.8 | 1.1 | 38 | | | | |
| Inboard | | 16-25 | 5 | 6,851 | 12 | 10.5 | 8.6 | 9.5 | .9 | 308 | | | | |
| Cruiser | | 16-25 | 2 | 7,178 | 9 | 8 | 6.5 | 7.2 | .7 | 100 | | | | |
| Cruiser | | 26-39 | 17 | 26,869 | 9 | 8 | 6.5 | 7.2 | .7 | 3,197 | 42 | 3 | 7.1 | 227 |
| Cruiser | | 40-64 | 3 | 96,181 | 9 | 8 | 6.5 | 7.2 | .7 | 2,020 | 42 | 7 | 16.7 | 337 |
| Sailboat | | 16-25 | 0 | 4,382 | 12 | 10.5 | 8.6 | 9.5 | .9 | 0 | | | | |
| Auxiliary Sailboat | | 16-25 | 1 | 10,328 | 9 | 8 | 6.5 | 7.2 | .7 | 72 | | | | |
| Auxiliary Sailboat | | 26-39 | 4 | 22,296 | 9 | 8 | 6.5 | 7.2 | .7 | 624 | 42 | 3 | 7.1 | 44 |
| Auxiliary Sailboat | | 40-64 | 1 | 52,729 | 9 | 8 | 6.5 | 7.2 | .7 | 369 | 42 | 7 | 16.7 | 61 |
| Total | | | 37 | | | | | | | 6,767 | | | | 669 |

## CALCULATION OF BENEFITS FOR PERMANENT MOORINGS - SCENARIO 2

D18. The fleet mix projected for Scenario 2 is virtually identical to the fleet mix projected for Scenario 1. Lacking empirical evidence to the contrary, it will be assumed that the fleet mix will be identical for both scenarios. Similarly, the distribution of new, transferred, new to vacated, and transferred to vacated remains the same as in Scenario 1. Tables D18 through D21 show the benefit calculations for a 400-berth facility, and Tables D22 through D25 provide the benefit calculations for a 600-berth facility. Since the rate at which demand absorbs capacity is assumed to be more rapid for the 600-berth facility under Scenario 2, an accelerated growth rate is used.

Table D18 - New Boats at 400-Mooring Facility at Geneva-on-the-Lake

Scenario 2

| Type | Class. | Size | Number of Boats | Average Depreciated Value | Rates of Return | | | | Gain | Value | On Cruise | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Ideal | Max. | Pres. | Future | | | Average Days Use | Average Days on Cruise | Percent Use | Value |
| | | (feet) | | $ | | | | | | $ | | | | $ |
| Outboard | | Less Than 16 | 28 | 1,183 | 15 | 13 | - | 13 | 13 | 4,306 | | | | |
| Outboard | | 16-25 | 12 | 3,450 | 15 | 13 | - | 13 | 13 | 5,382 | | | | |
| Inboard | | 16-25 | 53 | 6,851 | 12 | 10.5 | - | 10.5 | 10.5 | 38,126 | | | | |
| Cruiser | | 16-25 | 19 | 7,178 | 9 | 8 | - | 8 | 8 | 10,911 | | | | |
| Cruiser | | 26-39 | 124 | 26,868 | 9 | 8 | - | 8 | 8 | 266,531 | 42 | 3 | 7.1 | 18,924 |
| Cruiser | | 40-64 | 20 | 96,182 | 9 | 8 | - | 8 | 8 | 153,891 | 42 | 7 | 16.7 | 25,700 |
| Sailboat | | Less Than 16 | 4 | 834 | 12 | 10.5 | - | 10.5 | 10.5 | 350 | | | | |
| Sailboat | | 16-25 | 5 | 4,381 | 12 | 10.5 | - | 10.5 | 10.5 | 2,300 | | | | |
| Auxiliary Sailboat | | 16-25 | 3 | 10,328 | 9 | 8 | - | 8 | 8 | 2,479 | | | | |
| Auxiliary Sailboat | | 26-39 | 26 | 22,296 | 9 | 8 | - | 8 | 8 | 46,376 | 42 | 3 | 7.1 | 3,293 |
| Auxiliary Sailboat | | 40-64 | 3 | 52,729 | 9 | 8 | - | 8 | 8 | 12,655 | 42 | 7 | 16.7 | 2,113 |
| Total | | | 297 | | | | | | | 543,307 | | | | 50,030 |

Table D19 - Transferred Boats at 400-Berth Marina at Geneva-on-the-Lake

Scenario 2

| Type | Class. | Size | Number of Boats | Average Depreciated Value | Rates of Return | | | | Gain | Value | On Cruise | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Ideal | Max. | Pres. | Future | | | Average Days Use | Average Days on Cruise | Percent Use | Value |
| | | (feet) | | $ | | | | | | $ | | | | $ |
| Cruiser | | 16-25 | 9 | 7,178 | 9 | 8 | 7.2 | 8 | .8 | 517 | | | | |
| Cruiser | | 26-39 | 63 | 26,869 | 9 | 8 | 7.2 | 8 | .8 | 13,542 | 42 | 3 | 7.1 | 961 |
| Cruiser | | 40-64 | 11 | 96,182 | 9 | 8 | 7.2 | 8 | .8 | 8,464 | 42 | 7 | 16.7 | 1 413 |
| Auxiliary Sailboat | | 16-25 | 2 | 10,328 | 9 | 8 | 7.2 | 8 | .8 | 165 | | | | |
| Auxiliary Sailboat | | 26-39 | 12 | 22,296 | 9 | 8 | 7.2 | 8 | .8 | 2,140 | 42 | 3 | 7.1 | 152 |
| Auxiliary Sailboat | | 40-64 | 2 | 52,729 | 9 | 8 | 7.2 | 8 | .8 | 844 | 42 | 7 | 16.7 | 141 |
| Total | | | 99 | | | | | | | 25,672 | | | | 2,667 |

Table D20 - New Boats Utilizing Vacated Moorings Due to 400-Boat Marina at Geneva

Scenario 2

| Type | Class. | Size | Number of Boats | Average Depreciated Value | Rates of Return | | | | Gain | Value | On Cruise | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Ideal | Max. | Pres. | Future | | | Average Days Use | Average Days on Cruise | Percent Use | Value |
| | | (feet) | | $ | | | | | | $ | | | | $ |
| Outboard | | Less Than 16 | 5 | 1,183 | 15 | 13 | - | 11.8 | 11.8 | 698 | | | | |
| Outboard | | 16-25 | 2 | 3,450 | 15 | 13 | - | 11.8 | 11.8 | 814 | | | | |
| Inboard | | 16-25 | 10 | 6,851 | 12 | 10.5 | - | 9.5 | 9.5 | 6,508 | | | | |
| Cruiser | | 16-25 | 5 | 7,178 | 10 | 8 | - | 7.2 | 7.2 | 2,584 | | | | |
| Cruiser | | 26-39 | 36 | 26,868 | 9 | 8 | - | 7.2 | 7.2 | 69,642 | 42 | 3 | 7.1 | 4,945 |
| Cruiser | | 40-64 | 7 | 96,182 | 9 | 8 | - | 7.2 | 7.2 | 48,476 | 42 | 7 | 16.7 | 8,095 |
| Sailboat | | Less Than 16 | 1 | 834 | 12 | 10.5 | - | 9.5 | 9.5 | 79 | | | | |
| Sailboat | | 16-25 | 1 | 4,381 | 12 | 10.5 | - | 9.5 | 9.5 | 416 | | | | |
| Auxiliary Sailboat | | 16-25 | 1 | 10,328 | 9 | 8 | - | 7.2 | 7.2 | 744 | | | | |
| Auxiliary Sailboat | | 26-39 | 5 | 22,296 | 9 | 8 | - | 7.2 | 7.2 | 8,027 | 42 | 3 | 7.1 | 570 |
| Auxiliary Sailboat | | 40-64 | 1 | 52,729 | 9 | 8 | - | 7.2 | 7.2 | 3,796 | 42 | 7 | 16.7 | 634 |
| Total | | | 74 | | | | | | | 141,784 | | | | 14,244 |

Table D21 - Transfer Boats Utilizing Vacated Moorings Due to 400-Boat Marina at Geneva

Scenario 2

| Type | Class. | Size | Number of Boats | Average Depreciated Value | Rates of Return | | | | Gain | Value | On Cruise | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Ideal | Max. | Pres. | Future | | | Average Days Use | Average Days on Cruise | Percent Use | Value |
| | | (feet) | | $ | | | | | | $ | | | | $ |
| Outboard | | Less Than 16 | 2 | 1,183 | 15 | 13 | 10.7 | 11.8 | 1.1 | 26 | | | | |
| Outboard | | 16-25 | 1 | 3,450 | 15 | 13 | 10.7 | 11.8 | 1.1 | 37 | | | | |
| Inboard | | 16-25 | 3 | 6,851 | 12 | 10.5 | 8.6 | 9.5 | .9 | 185 | | | | |
| Cruiser | | 16-25 | 2 | 7,178 | 9 | 8 | 6.5 | 7.2 | .7 | 100 | | | | |
| Cruiser | | 26-39 | 11 | 26,868 | 9 | 8 | 6.5 | 7.2 | .7 | 2,069 | 42 | 3 | 7.1 | 147 |
| Cruiser | | 40-64 | 2 | 96,182 | 9 | 8 | 6.5 | 7.2 | .7 | 1,347 | 42 | 7 | 16.7 | 225 |
| Sailboat | | Less Than 16 | - | - | - | - | - | - | | | | | | |
| Sailboat | | 16-25 | - | - | - | - | - | - | | | | | | |
| Auxiliary Sailboat | | 16-25 | 1 | 10,328 | 9 | 8 | 6.5 | 7.2 | .7 | 72 | | | | |
| Auxiliary Sailboat | | 26-39 | 2 | 22,296 | 9 | 8 | 6.5 | 7.2 | .7 | 312 | 42 | 3 | 7.1 | 22 |
| Auxiliary Sailboat | | 40-64 | 1 | 52,729 | 9 | 8 | 6.5 | 7.2 | .7 | 369 | 42 | 7 | 16.7 | 62 |
| Total | | | 25 | | | | | | | 4,517 | | | | 456 |

Table D22 - New Boats at 600-Mooring Facility at Geneva-on-the-Lake

Scenario 2

| Type | Class. | Size | Number of Boats | Average Depreciated Value | Rates of Return | | | | Gain | Value | On Cruise | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Ideal | Max. | Pres. | Future | | | Average Days Use | Average Days on Cruise | Percent Use | Value |
| | | (feet) | | $ | | | | | | $ | | | | $ |
| Outboard | | Less Than 16 | 42 | 1,183 | 15 | 13 | - | 13 | 13 | 6,459 | | | | |
| Outboard | | 16-25 | 18 | 3,450 | 15 | 13 | - | 13 | 13 | 8,073 | | | | |
| Inboard | | 16-25 | 79 | 6,851 | 12 | 10.5 | - | 10.5 | 10.5 | 56,829 | | | | |
| Cruiser | | 16-25 | 28 | 7,178 | 9 | 8 | - | 8 | 8 | 16,079 | | | | |
| Cruiser | | 26-39 | 183 | 26,868 | 9 | 8 | - | 8 | 8 | 393,348 | 42 | 3 | 7.1 | 27,927 |
| Cruiser | | 40-64 | 30 | 96,182 | 9 | 8 | - | 8 | 8 | 230,837 | 42 | 7 | 16.7 | 38,550 |
| Sailboat | | Less Than 16 | 7 | 834 | 12 | 10.5 | - | 10.5 | 10.5 | 613 | | | | |
| Sailboat | | 16-25 | 8 | 4,382 | 12 | 10.5 | - | 10.5 | 10.5 | 3,681 | | | | |
| Auxiliary Sailboat | | 16-25 | 7 | 10,328 | 9 | 8 | - | 8 | 8 | 5,784 | | | | |
| Auxiliary Sailboat | | 26-39 | 38 | 22,296 | 9 | 8 | - | 8 | 8 | 67,780 | 42 | 3 | 7.1 | 4,812 |
| Auxiliary Sailboat | | 40-64 | 5 | 52,729 | 9 | 8 | - | 8 | 8 | 21,092 | 42 | 7 | 16.7 | 3,522 |
| Total | | | 445 | | | | | | | 810,575 | | | | 74,811 |

Table D23 - Transferred Boats at 600-Mooring Facility at Geneva-on-the-Lake

Scenario 2

| Type | Class. | Size | Number of Boats | Average Depreciated Value | Rates of Return: Ideal | Rates of Return: Max. | Rates of Return: Pres. | Rates of Return: Future | Gain | Value | On Cruise: Average Days Use | On Cruise: Average Days on Cruise | On Cruise: Percent Use | On Cruise: Value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (feet) | | $ | | | | | | $ | | | | $ |
| Cruiser | | 16-25 | 14 | 7,178 | 9 | 8 | 7.2 | 8 | .8 | 804 | | | | |
| Cruiser | | 26-39 | 94 | 26,868 | 9 | 8 | 7.2 | 8 | .8 | 20,205 | 42 | 3 | 7.1 | 1,434 |
| Cruiser | | 40-64 | 16 | 96,182 | 9 | 8 | 7.2 | 8 | .8 | 12,311 | 42 | 7 | 16.7 | 2,056 |
| Auxiliary Sailboat | | 16-25 | 3 | 10,328 | 9 | 8 | 7.2 | 8 | .8 | 248 | | | | |
| Auxiliary Sailboat | | 26-39 | 20 | 22,296 | 9 | 8 | 7.2 | 8 | .8 | 3,567 | 42 | 3 | 7.1 | 253 |
| Auxiliary Sailboat | | 40-64 | 2 | 52,729 | 9 | 8 | 7.2 | 8 | .8 | 844 | 42 | 7 | 16.7 | 142 |
| Total | | | 149 | | | | | | | 37,979 | | | | 3,885 |

Table D24 - New Boats Utilizing Vacated Moorings for 600-Berth Facility at Geneva

Scenario 2

| Type | Class. | Size | Number of Boats | Average Depreciated Value | Rates of Return | | | | Gain | Value | On Cruise | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Ideal | Max. | Pres. | Future | | | Average Days Use | Average Days on Cruise | Percent Use | Value |
| | | (feet) | | $ | | | | | | $ | | | | $ |
| Outboard | | Less Than 16 | 8 | 1,183 | 15 | 13 | - | 11.8 | 11.8 | 922 | | | | |
| Outboard | | 16-25 | 3 | 3,449 | 15 | 13 | - | 11.8 | 11.8 | 1,221 | | | | |
| Inboard | | 16-25 | 15 | 6,851 | 12 | 10.5 | - | 9.5 | 9.5 | 9,763 | | | | |
| Cruiser | | 16-25 | 8 | 7,178 | 9 | 8 | - | 7.2 | 7.2 | 4,135 | | | | |
| Cruiser | | 26-39 | 52 | 26,869 | 9 | 8 | - | 7.2 | 7.2 | 100,598 | 42 | 3 | 7.1 | 7,142 |
| Cruiser | | 40-64 | 9 | 96,182 | 9 | 8 | - | 7.2 | 7.2 | 62,326 | 42 | 7 | 16.7 | 10,408 |
| Sailboat | | Less Than 16 | 1 | 834 | 12 | 10.5 | - | 9.5 | 9.5 | 79 | | | | |
| Sailboat | | 16-25 | 1 | 4,382 | 12 | 10.5 | - | 9.5 | 9.5 | 416 | | | | |
| Auxiliary Sailboat | | 16-25 | 2 | 10,328 | 9 | 8 | - | 7.2 | 7.2 | 1,487 | | | | |
| Auxiliary Sailboat | | 26-39 | 11 | 22,296 | 9 | 8 | - | 7.2 | 7.2 | 17,658 | 42 | 3 | 7.1 | 1,254 |
| Auxiliary Sailboat | | 40-64 | 2 | 52,729 | 9 | 8 | - | 7.2 | 7.2 | 7,593 | 42 | 7 | 16.7 | 1,268 |
| Total | | | 112 | | | | | | | 206,198 | | | | 20,072 |

Table D25 - Transferred Boats at Vacated Facilities with 600-Berth Facility at Geneva

Scenario 2

| Type | Class. | Size | Number of Boats | Average Depreciated Value | Rates of Return | | | | Gain | Value | On Cruise | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Ideal | Max. | Pres. | Future | | | Average Days Use | Average Days on Cruise | Percent Use | Value |
| | | (feet) | | $ | | | | | | $ | | | | $ |
| Outboard | | Less Than 16 | 3 | 1,183 | 15 | 13 | 10.7 | 11.8 | 1.1 | 39 | | | | |
| Outboard | | 16-25 | 1 | 3,450 | 15 | 13 | 10.7 | 11.8 | 1.1 | 38 | | | | |
| Inboard | | 16-25 | 5 | 6,851 | 12 | 10.5 | 8.6 | 9.5 | .9 | 308 | | | | |
| Cruiser | | 16-25 | 2 | 7,178 | 9 | 8 | 6.5 | 7.2 | .7 | 100 | | | | |
| Cruiser | | 26-39 | 17 | 26,869 | 9 | 8 | 6.5 | 7.2 | .7 | 3,197 | 42 | 3 | 7.1 | 227 |
| Cruiser | | 40-64 | 3 | 96,181 | 9 | 8 | 6.5 | 7.2 | .7 | 2,020 | 42 | 7 | 16.7 | 337 |
| Sailboat | | 16-25 | 0 | 4,382 | 12 | 10.5 | 8.6 | 9.5 | .9 | 0 | | | | |
| Auxiliary Sailboat | | 16-25 | 1 | 10,328 | 9 | 8 | 6.5 | 7.2 | .7 | 72 | | | | |
| Auxiliary Sailboat | | 26-39 | 4 | 22,296 | 9 | 8 | 6.5 | 7.2 | .7 | 624 | 42 | 3 | 7.1 | 44 |
| Auxiliary Sailboat | | 40-64 | 1 | 52,729 | 9 | 8 | 6.5 | 7.2 | .7 | 369 | 42 | 7 | 16.7 | 62 |
| Total | | | 37 | | | | | | | 6,767 | | | | 670 |

D19. According to EM 1120-2-113, Benefit Evaluation and Cost-Sharing for Small-Boat Harbor Projects, the benefits are based on the fleet served. While the greater demand for Scenario 2 should increase the value of each mooring, it is not reflected in this methodology (demand pressure for each mooring would increase the "willingness to pay" for boating access).

CALCULATION OF BENEFITS FOR TRAILERED AND TRANSIENT BOATS

D20. Trailer launchings are calculated in a slightly different manner. The number of peak-day launchings for power and sail have been calculated for both scenarios. The next step is to compare the demand for launchings to the available ramps, and estimate annual launches by boat type.

D21. The 1975 Ohio SCORP estimates instant peak-day capacity/per ramp of 20 boats. This is based on including one acre of parking for 20 cars and trailers. A turnover rate of 2.0 is applied to arrive at daily peak-day capacity of 40 launches per ramp. With 14 ramps in Ashtabula County, there can be 560 launches per peak-day. Demand for launches in 1970 was for 3,090 peak-day launches per peak-day. The seasonal launchings per ramp are calculated as a weighted average of power and sail use.

D22. The boat launching season lasts for 180 days (mid-April to mid-October). There are 50 days which would prohibit powerboating (precipitation) and 60 days which prohibit sailing (wind speed, precipitation). This is based on long-range climate averages. Annual ramp capacities are calculated as follows:

| | Power | Sail |
|---|---|---|
| No. Day Season | 180 | 180 |
| No. Prohibitive Days | 50 | 60 |
| | 130 | 120 |
| No. Peak Days | 24 | 27 |
| No. Nonpeak Days | 106 | 93 |
| Launches/Peak Day[1] | 40 | 40 |
| Launches/Nonpeak[1] | 18 | 18 |
| Annual Launches | 2,868 | 2,754 |

D23. In 1990, 85.7 percent of all launches demanded are power, 14.3 percent sail. This results in average ramp capacity of 2,852 annual launches. Since there are 14 ramps in Ashtabula County, this results in a 39,928 annual launch capacity on Lake Erie. The proposed improvements will add two ramps, or provide for 5,696 additional

1/ Based on NYS Parks & Recreation Calculations

launchings per year. The scenarios differ slightly in the demand for launches. The difference is very slight (for the same reasons as for moored boats) but it is measurable.

D24. Scenario 1, peak-day launch demand, is for 1,980 powerboats and 330 sailboats. By comparing these launches to annual launches, it is estimated that 94,446 annual power launches are demanded and 13,811 sail launches. Power (87 percent) will then account for 4,956 of the annual launches added, while sail accounts for 740. All launches are assumed to be less than 16 feet. Equivalent boats are found by dividing launches by use-days (50, based on New York State average - 42, increased to reflect greater benefit to moored boats). This results in 99.1 equivalent powerboats and 6.6 sailboats. Scenario 2, peak-day launches demand, is 2,070 power and 290 sail. Annual launches total 98,739 (89 percent) power and 12,137 (11 percent) sail. This equals 5,069 power launches and 627 sail launches due to increased capacity. Equivalent boats - 101.4 (power) and 12.5 (sail).

D25. Transient traffic will be unaffected by the development scenario. All slips will be utilized on peak-days, three will be used on 50 percent of nonpeak days, one will be used for 25 percent of nonpeak days. Therefore, the 400-mooring facility will accommodate 290 transient visits of two days, the 600-berth facility will accommodate 344 two-day visits. The visits are distributed to cruisers and auxiliary sailboats greater than 26 feet in length.

| | | | | | Equiv. Bts. |
|---|---|---|---|---|---|
| 400-Mooring Marina | | | | | |
| Cruisers (26-39) | 400 | (Days Visit) | 42 | = | 9.5 |
| Cruisers (40-64) | 67 | (Days Visit) | 42 | = | 1.6 |
| Aux. Sail (26-34) | 100 | (Days Visit) | 42 | = | 2.4 |
| Aux. Sail (40-64) | 13 | (Days Visit) | 42 | = | 0.3 |
| 600-Mooring Marina | | | | | |
| Cruisers (26-39) | 474 | (Day-Visit) | 42 | = | 11.3 |
| Cruisers (40-64) | 79 | (Day-Visit) | 42 | = | 1.9 |
| Aux. Sail (26-39) | 120 | (Day-Visit) | 42 | = | 2.9 |
| Aux. Sail (40-64) | 15 | (Day-Visit) | 42 | = | 0.4 |

D26. Of course, boats of these types kept at Geneva would be on cruise for a portion of the season. It is expected that boats 26 feet to 39 feet will be on cruise for three days (or 7.1 percent of the season) of their 42 use-days. Larger boats will be on cruise seven days (or 16.7 percent). The benefit to each boat class will be reduced by these percentages to account for the time spent on cruise.

D27. The benefits for permanent-based boats, modified to reflect time spent on cruise, were shown in Tables D12 through D25. Tables D26 through D29 show the calculations for trailered and transient boats for each scenario and development alternative.

Table D26 - No Steel Mill Trailered Boats - 400-Berth Marina

Scenario 1

| Type | Launches | Size | Equiv. Number of Boats | Average Depreciated Value | Rates of Return | | | | Value | On Cruise | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Ideal | Max. | Pres. | Future | | Average Days Use | Average Days on Cruise | Percent Use | Value |
| | | (feet) | | $ | | | | | $ | | | | $ |
| Outboard | 4,956 | Under 16' | 99.1 | 1,183 | 15 | 13 | - | 13 | 15,241 | | | | |
| Sailboat | 740 | Under 16' | 6.6 | 834 | 12 | 10.5 | - | 10.5 | 578 | | | | |
| Total | 5,696 | | 105.7 | | | | | | 15,819 | | | | |

No Steel Mill Transient Boats - 400-Berth Marina

Scenario 1

| Type | Visit-Days | Size | Equiv. Number of Boats | Average Depreciated Value | Rates of Return | | | | Value | On Cruise | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Ideal | Max. | Pres. | Future | | Average Days Use | Average Days on Cruise | Percent Use | Value |
| | | (feet) | | $ | | | | | $ | | | | $ |
| Cruiser | 400 | 26-39 | 9.5 | 26,869 | 9 | 8 | - | 8 | 20,420 | | | | |
| Cruiser | 67 | 40-64 | 1.6 | 96,182 | 9 | 8 | - | 8 | 12,311 | | | | |
| Auxiliary Sailboat | 100 | 26-39 | 2.4 | 22,296 | 9 | 8 | - | 8 | 4,281 | | | | |
| Auxiliary Sailboat | 13 | 40-64 | 0.3 | 52,729 | 9 | 8 | - | 8 | 1,265 | | | | |
| Total | 580 | | 13.8 | | | | | | 38,277 | | | | |

Table D27 - No Steel Mill Trailered Boats - 600-Berth Marina

Scenario 1

| Type | Launches | Size | Equiv. Number of Boats | Average Depreciated Value | Rates of Return | | | | Value | On Cruise | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Ideal | Max. | Pres. | Future | | Average Days Use | Average Days on Cruise | Percent Use | Value |
| | | (feet) | | $ | | | | | $ | | | | $ |
| Outboard | 4,956 | Under 16' | 99.1 | 1,183 | 15 | 13 | - | 13 | 15,241 | | | | |
| Sailboat | 740 | Under 16' | 6.6 | 834 | 12 | 10.5 | - | 10.5 | 578 | | | | |
| Total | 5,696 | | 105.7 | | | | | | 15,819 | | | | |

No Steel Mill Transient Boats - 600-Berth Marina

Scenario 1

| Type | Visit-Days | Size | Equiv. Number of Boats | Average Depreciated Value | Rates of Return | | | | Value | On Cruise | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Ideal | Max. | Pres. | Future | | Average Days Use | Average Days on Cruise | Percent Use | Value |
| | | (feet) | | $ | | | | | $ | | | | $ |
| Cruiser | 474 | 26-39 | 11.3 | 26,869 | 9 | 8 | - | 8 | 24,290 | | | | |
| Cruiser | 79 | 40-64 | 1.9 | 96,182 | 9 | 8 | - | 8 | 14,620 | | | | |
| Auxiliary Sailboat | 120 | 26-39 | 2.9 | 22,296 | 9 | 8 | - | 8 | 5,173 | | | | |
| Auxiliary Sailboat | 15 | 40-64 | 0.4 | 52,729 | 9 | 8 | - | 8 | 1,687 | | | | |
| Total | 688 | | 16.5 | | | | | | 45,770 | | | | |

Table D28 - With Steel Mill Trailered Boats - 400-Berth Marina

Scenario 2

| Type | Launches | Size | Equiv. Number of Boats | Average Depreciated Value | Rates of Return: Ideal | Rates of Return: Max. | Rates of Return: Pres. | Rates of Return: Future | Value | On Cruise: Average Days Use | On Cruise: Average Days on Cruise | On Cruise: Percent Use | On Cruise: Value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (feet) | | $ | | | | | $ | | | | $ |
| Outboard | 5,069 | Under 16' | 101.4 | 1,183 | 15 | 13 | - | 13 | 15,594 | | | | |
| Sailboat | 627 | Under 16' | 12.5 | 834 | 12 | 10.5 | - | 10.5 | 1,095 | | | | |
| Total | 5,696 | | 113.9 | | | | | | 16,689 | | | | |

With Steel Mill Transient Boats - 400-Berth Marina

Scenario 2

| Type | Visit-Days | Size | Equiv. Number of Boats | Average Depreciated Value | Rates of Return: Ideal | Rates of Return: Max. | Rates of Return: Pres. | Rates of Return: Future | Value | On Cruise: Average Days Use | On Cruise: Average Days on Cruise | On Cruise: Percent Use | On Cruise: Value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (feet) | | $ | | | | | $ | | | | $ |
| Cruiser | 400 | 26-39 | 9.5 | 24,650 | 9 | 8 | - | 8 | 18,734 | | | | |
| Cruiser | 67 | 40-64 | 1.6 | 88,240 | 9 | 8 | - | 8 | 11,295 | | | | |
| Auxiliary Sailboat | 100 | 26-39 | 2.4 | 20,455 | 9 | 8 | - | 8 | 3,927 | | | | |
| Auxiliary Sailboat | 13 | 40-64 | 0.3 | 48,375 | 9 | 8 | - | 8 | 1,161 | | | | |
| Total | 580 | | 13.8 | | | | | | 35,117 | | | | |

## Table D29 - With Steel Mill Trailered Boats - 600-Berth Marina

Scenario 2

| Type | Launches | Size | Equiv. Number of Boats | Average Depreciated Value | Rates of Return | | | | Value | On Cruise | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Ideal | Max. | Pres. | Future | | Average Days Use | Average Days on Cruise | Percent Use | Value |
| | | (feet) | | $ | | | | | $ | | | | $ |
| Outboard | 5,069 | Under 16' | 101.4 | 1,183 | 15 | 13 | - | 13 | 15,594 | | | | |
| Sailboat | 627 | Under 16' | 12.5 | 834 | 12 | 10.5 | - | 10.5 | 1,095 | | | | |
| Total | 5,696 | | 113.9 | | | | | | 16,689 | | | | |

## With Steel Mill Transient Boats - 600-Berth Marina

Scenario 2

| Type | Visit-Days | Size | Equiv. Number of Boats | Average Depreciated Value | Rates of Return | | | | Value | On Cruise | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Ideal | Max. | Pres. | Future | | Average Days Use | Average Days on Cruise | Percent Use | Value |
| | | (feet) | | $ | | | | | $ | | | | $ |
| Cruiser | 474 | 26-39 | 11.3 | 26,869 | 9 | 8 | - | 8 | 24,290 | | | | |
| Cruiser | 79 | 40-64 | 1.9 | 96,182 | 9 | 8 | - | 8 | 14,620 | | | | |
| Auxiliary Sailboat | 120 | 26-39 | 2.9 | 22,296 | 9 | 8 | - | 8 | 5,173 | | | | |
| Auxiliary Sailboat | 15 | 40-64 | 0.4 | 52,729 | 9 | 8 | - | 8 | 1,687 | | | | |
| Total | 688 | | | | | | | | 45,770 | | | | |

SUMMARY OF DIRECT NAVIGATION BENEFITS

D28. Benefit display of direct navigation benefits:

Table D30 - Direct Navigation Benefits

| | Scenario 1 | | Scenario 2 | |
|---|---|---|---|---|
| | Total | Average Annual Benefits | Total | Average Annual Benefits |
| 400-Mooring Marina 1/ | | | | |
| New | 491,982 | 388,961 | 493,277 | 389,985 |
| Transferred | 22,970 | 18,160 | 23,005 | 18,188 |
| New at Vacated Moorings | 127,542 | 100,834 | 127,540 | 100,833 |
| Trans. to Vacated Moorings | 4,062 | 3,211 | 4,062 | 3,211 |
| Trailered | 15,819 | 12,507 | 16,689 | 13,194 |
| Transient | 38,277 | 30,262 | 38,277 | 30,262 |
| Total | 700,652 | 553,935 | 702,850 | 555,673 |
| 600-Mooring Marina | | | | |
| New | 735,776 | 408,871 2/ | 735,764 | 547,923 3/ |
| Transferred | 34,092 | 18,945 2/ | 34,094 | 25,390 3/ |
| New at Vacated Moorings | 186,126 | 103,430 2/ | 186,126 | 138,608 3/ |
| Trans. to Vacated Moorings | 6,098 | 3,389 2/ | 6,098 | 4,541 3/ |
| Trailered | 15,819 | 12,507 1/ | 16,689 | 13,194 1/ |
| Transient | 45,770 | 25,434 2/ | 45,770 | 25,434 3/ |
| Total | 1,023,681 | 572,576 | 1,024,541 | 755,090 |

1/ Average Annual Equivalent Factor = .7906 (Normal Growth)
2/ Average Annual Equivalent Factor = .5557 (Straight Line Growth)
3/ Average Annual Equivalent Factor = .7447 (Accelerated Growth)

Note: Normal Growth was used to represent an "adjustment" of demand to capacity. Straight Line and Accelerated Growth were used to represent "growth" of demand to capacity - straight line growth for Scenario 1 and acceleration growth for Scenario 2.

## SUMMARY OF TOTAL NAVIGATION BENEFITS

D29. An additional navigation benefit that would occur at Geneva is for providing refuge. A $10,000 annual benefit for all scenarios and marina sizes is used to represent this category. Summarizing Navigation Benefits, we obtain:

| | Navigation Benefits |
|---|---|
| Scenario 1 - 400 Berths - | $563,935 |
| Scenario 2 - 400 Berths - | 565,673 |
| Scenario 1 - 600 Berths - | 582,576 |
| Scenario 2 - 600 Berths - | 765,090 |

## SENSITIVITY ANALYSIS OF BENEFITS

D30. It is apparent in paragraph D28 that under Scenario 1, a 50 percent increase in berth capacity from 400 to 600 will increase Navigation Benefits by only 3.3 percent, and the same increase in berth capacity under Scenario 2 will increase navigation benefits by 35 percent. Since Scenario 1 is, at the present time, the more-likely-to-occur scenario, it appears that the incremental benefits resulting from an increase in berth capacity are quite small and are not likely to be matched by a less-than-proportionate increase in costs.

## OPTIMUM PLAN BASED ON ECONOMIC EFFICIENCY CRITERIA

D31. Table D31 summarizes the relevant efficiency measures.

Table D31 - Economic Efficiency Criteria

| | Average Annual Benefits 1/ | Average Annual Costs 2/ | Net Benefits | Benefit/ Cost Ratio |
|---|---|---|---|---|
| Alternative 1 | 563,935 | 403,300 | 160,635 | 1.39 |
| Alternative 2 | 563,935 | 374,700 | 189,235 | 1.50 |
| Alternative 3 | 563,935 | 310,700 | 253,235 | 1.82 |
| Alternative 4 | 563,935 | 256,800 | 307,135 | 2.19 |

1/ Does not include Fishing Benefits
2/ Does not include mitigation for fish and wildlife

Alternative 4 is the optimum alternative because it yields both the largest Net Benefits and the largest Benefit-Cost ratio.

## SUPPLEMENTARY ANALYSIS OF FISHING DEMAND

D32. Paragraph D8 left the fishing recreationist demand as it was generated by origin-zone for peak-day use. The peak-day use should be allocated to Ashtabula County by use of travel time and alternate site factors. The 1975 Ohio SCORP found that less than 10 percent of the fishing activity occasions are transferred out of the origin-county. In order to reflect this, 90 percent of Ashtabula County's demand is expected to remain in the county, and one percent from Zone 2 would be willing to travel to Ashtabula County on any particular peak-day. This results in total fishermen willing to travel to the county. The alternate site factor (county level) is found by comparing Ashtabula County's available access to the regional total (including Erie and Crawford Counties, PA, and Chautauqua County, NY). Available shoreline in Ashtabula County (1,561,026 linear feet) is compared to the region (14,252,832 linear feet) to result in an alternate site factor for Zone 2 of 0.11. These factors combine to result in peak-day shoreline fishermen (in thousands):

| | Scenario 1 | | | Scenario 2 | | |
|---|---|---|---|---|---|---|
| | Zone 1 | Zone 2 | Total | Zone 1 | Zone 2 | Total |
| 1970 | 3.57 | 0.16 | 3.73 | 3.57 | 0.16 | 3.73 |
| 1980 | 4.39 | 0.18 | 4.57 | 4.52 | 0.18 | 4.70 |
| 1990 | 5.07 | 0.20 | 5.27 | 5.41 | 0.21 | 5.62 |
| 2000 | 5.66 | 0.22 | 5.88 | 6.01 | 0.23 | 6.24 |
| 2010 | 6.24 | 0.24 | 6.48 | 6.63 | 0.24 | 6.87 |
| 2020 | 6.77 | 0.25 | 7.02 | 7.18 | 0.26 | 7.44 |
| 2030 | 7.44 | 0.27 | 7.71 | 7.90 | 0.27 | 8.17 |

D33. Lake Erie available shoreline, in linear feet, is 317,840. Since this accounts for 20.4 percent of the county's fishing access, demand is allocated to Lake Erie by this ratio:

| | Scenario 1 | Scenario 2 |
|---|---|---|
| 1970 | 0.76 | 0.76 |
| 1980 | 0.93 | 0.96 |
| 1990 | 1.07 | 1.15 |
| 2000 | 1.20 | 1.27 |
| 2010 | 1.32 | 1.40 |
| 2020 | 1.43 | 1.52 |
| 2030 | 1.57 | 1.67 |

D34. The capacity standards in Ohio's SCORP lists one fisherman for every 264 feet of available shoreline. This is a raw standard, since

not all the shoreline is accessible. However, this figure results in available capacity of 1,200 fishermen. A turnover rate of 2.0 is applied to result in peak-day capacity of 2,400 fishermen in Ashtabula County. Demand, however, is expected to remain well below capacity throughout the project-life period.

D35. Because of the apparent conflict between the results of the regional fishing demand analysis and the need for additional recreational fishing facilities as expressed at the initial public meeting on 22 March 1978, the demand analysis will be reevaluated in Stage 3.

APPENDIX E

PERTINENT CORRESPONDENCE

GENEVA-ON-THE-LAKE SMALL-BOAT HARBOR

STAGE 2 REPORT
OF
REFORMULATION PHASE I GENERAL DESIGN MEMORANDUM

U. S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, NY 14207

APPENDIX E

PERTINENT CORRESPONDENCE

| | |
|---|---|
| Exhibit E-1 | 10 November 1977 letter from Dr. Teater of ODNR to Buffalo District Engineer regarding ODNR's intent to furnish the items of local cooperation as presented in House Document No. 91-402. |
| Exhibit E-2 | 16 March 1972 letter from Mr. Fred Wampler of ODNR to Buffalo District Acting Chief, Engineering Division stating ODNR's intention to provide assistance to local communities for their share of the financial support of the Geneva-on-the-Lake project. |
| Exhibit E-3 | 24 July 1969 letter from Director Moor of ODNR to Buffalo District Engineer regarding ODNR's intent to furnish the items of local cooperation as presented in the 1969 Interim Report. |
| Exhibit E-4 | 8 February 1979 letter from Buffalo District Engineer to Division Engineer, North Central Division, requesting that the Waterways Experiment Station furnish Buffalo District with an estimate of the cost and schedule to conduct a model study for the Geneva-on-the-Lake Small-Boat Harbor Study (with 1st, 2nd, and 3rd indorsements). |
| Exhibit E-5 | 18 April 1979 letter from Buffalo District Engineer to Division Engineer, North Central Division, requesting approval to conduct a model study for the Geneva-on-the-Lake Small Boat Harbor Study (with 1st, 2nd, and 3rd indorsements). |
| Exhibit E-6 | 3 November 1978 letter from Regional Archaeological Preservationist, Ohio Historic Preservation Office, to Buffalo District Engineer regarding existing cultural resources in the area of Geneva State Park, OH. |
| Exhibit E-7 | 14 November 1978 telephone conversation record between Buffalo District and Mr. Peter Delworth regarding existing cultural resources in the area of Geneva State Park, OH. |

APPENDIX E

PERTINENT CORRESPONDENCE
(Cont'd)

| | |
|---|---|
| Exhibit E-8 | 2 July 1979 letter from Conrad Fjetland of the U.S. Fish & Wildlife Service stating that agency's position on further consideration of the four structural plans for the small boat harbor. |
| Exhibit E-9 | 6 July 1979 letter from Conrad Fjetland of the U.S. Fish and Wildlife Service modifying his letter of 2 July 1979 (Exhibit E-8). |
| Exhibit E-10 | 17 July 1979 letter from James Swartzmiller of Ohio Department of Natural Resources indicating that agency's preference for Plan 3. |
| Exhibit E-11 | 13 June 1979 letter from Buffalo District Engineer to James Swartzmiller of ODNR presenting Buffalo District's interpretation of Executive Order 11990 as it relates to evaluation of practical alternatives for the Geneva-on-the-Lake Small-Boat Harbor Study. (NOTE: Similar letter sent to Conrad A. Fjetland of the U.S. Fish and Wildlife Service.) |

ODNR
Ohio Department of Natural Resources
Fountain Square · Columbus Ohio 43224 · (614) 466-3770

November 10, 1977

COL Daniel D. Ludwig, District Engineer
U. S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Ludwig:

Reference is made to your letter of 28 September 1977 and to our subsequent meeting of 31 October 1977 concerning the proposed harbor of refuge for Geneva State Park at Lake Erie.

Your 28 September letter expresses two basic concerns which you have noted may delay the schedule for completion of advanced engineering and design for the proposed project.

The first concern relates to the location of a dock channel and maneuvering area as originally proposed. The land where these facilities were to be located now is occupied by a parking area that was constructed by this department to serve the beach at Geneva State Park. In this regard, I have been advised by my Office of the Chief Engineer that the location of the parking area was coordinated with your office at the time of construction. It is my understanding that this presented no problems at the time in that the dock channel and maneuvering area would have to be relocated for the small boat harbor project, but that the necessary relocation would not present significant difficulties.

Your second concern relates to the State's ability to provide the non-federal assurances as presented in House Document No. 91-402. We have reviewed these items of local cooperation and based upon the funding currently contained in our capital improvements appropriation we wish to reiterate the intent of the Ohio Department of Natural Resources to provide such assurances.

After reviewing your 28 September correspondence and having the opportunity to discuss this matter with you on 31 October, I wish, at this time, to express my concern over your estimated three years to complete preconstruction planning.



EXHIBIT E-1

COL Daniel D. Ludwig, District Engineer
Page Two
November 10, 1977

This project is of vital importance to the many boaters who navigate the Lake Erie waters off the shores of Geneva State Park. Congress recognized the need for the project and provided appropriate authorization almost eight years ago, and advanced engineering and design is just now beginning. Therefore, I am requesting that every consideration be given to shortening the estimated time schedule to complete preconstruction planning to two years in lieu of the three years that is presently proposed.

Sincerely,

Robert W. Teater

ROBERT W. TEATER
Director

RWT:gfs

JHN J. GILLIGAN
GOVERNOR

WILLIAM B. NYE
DIRECTOR

STATE OF OHIO
# DEPARTMENT OF NATURAL RESOURCES
OHIO DEPARTMENTS BUILDING
COLUMBUS 43215

March 16, 1972

Mr. Joseph G. Weinrub
Acting Chief, Engineering Division
U. S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, New York 14207

Small-Boat Harbor Reports
Coast of Lake Erie

Dear Mr. Weinrub:

Reference is made to your letter of February 11, 1972 to S. L. Frost requesting our comments with regard to the small-boat harbor reports listed hereunder:

a. Lorain Harbor
b. Avon-on-the-Lake
c. Chagrin River
d. Fairport Harbor
e. Geneva-on-the-Lake State Park
f. Ashtabula Harbor
g. Conneaut Harbor

The listed localities have been reviewed by the Division of Watercraft and our engineering and planning sections, agencies within our department with specific interest in these projects. Based upon the results of this review, it is the position of the Ohio Department of Natural Resources to support the initiation of the studies for Avon-on-the-Lake and Lorain Harbor. We also wish to provide our support for the construction of the projects as authorized for Geneva-on-the-Lake State Park, Chagrin River, and Conneaut Harbor. Furthermore, this letter is to serve as our concurrence for the draft report for Fairport Harbor and the preliminary planning for Ashtabula Harbor.

In regard to non-Federal financial support, it is our intent to provide, when necessary and subject to availability of funds, assistance to the local communities for their share in completion of the projects.

It is hoped that the information provided in the preceding paragraphs will help "clear up" any questions concerning Department of Natural Resources support for the listed harbors of refuge.

EXHIBIT E-2

We appreciate the opportunity to provide our comments and trust that you will not hesitate to call upon us in the event you should have any questions regarding our position.

Sincerely,

Fred Wampler

Fred Wampler
State-Federal Coordinator

FW:bg

cc: S. L. Frost

JAMES A. RHODES
GOVERNOR

FRED E. MORR
DIRECTOR

STATE OF OHIO
DEPARTMENT OF NATURAL RESOURCES
OHIO DEPARTMENTS BUILDING
COLUMBUS 43215

July 24, 1969

Colonel Ray S. Hansen
District Engineer
U. S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, New York 14207

Geneva-on-the-Lake -
Improvements for Small Boat Navigation

Dear Colonel Hansen:

Reference is made to your survey report on improvements for small boat navigation at Geneva-on-the-Lake and the Division Engineer's public notice dated 2 May 1969 regarding the report and the recommended project.

Due to the critical shortage of recreational facilities in this part of our state the Department of Natural Resources has acquired 465 acres at Geneva-on-the-Lake at a cost of $1, 146, 000 for this project as well as other improvements for general recreation. The Department is presently finishing a construction contract for $1, 000, 000 which will provide a swimming beach and bathhouse with showers and lockers, picnic and play areas with shelters and restrooms, and parking facilities for 2, 100 automobiles. In addition to these facilities we have programmed for the next biennium the development of a camping area with 300 sites for tents and trailers, construction of 30 vacation cabins and development of a marina for recreational craft at an estimated cost of $3, 600, 000.

As the result of our review of the survey report we find the plan of development acceptable and in keeping with the general recreation master plan for Geneva State Park. However, due to the concurrent development at the site it may be necessary to make certain minor adjustments during the advance engineering and design phase of the project.

Exhibit E-3

Under the authority granted the Director of the Department of Natural Resources in Section 1501.02, Ohio Revised Code, I will furnish the non-Federal assurances for items "a" and "c" through "k", inclusive, as indicated on pages 27 and 28 of the survey report. Insofar as the Ohio constitutional and statutory authorities provide, assurances for item "b" will also be furnished.

In view of the urgent need for this small boat navigation project to be developed concurrently with the state recreation development at Geneva State Park, it is hoped that authorization and funding for this improvement at Geneva-on-the-Lake for small boat navigation will receive early and favorable consideration by the Congress.

Sincerely,

Fred E. Morr

FRED E. MORR,
Director

FEM:bg

**DEPARTMENT OF THE ARMY**
**BUFFALO DISTRICT, CORPS OF ENGINEERS**
**1776 NIAGARA STREET**
**BUFFALO, NEW YORK 14207**

NCBED-PW 8 February 1979

SUBJECT: Proposed Model Study of Geneva-on-the-Lake, Ohio, Small-Boat Harbor

Division Engineer, North Central
ATTN: NCDED-C

1. The purpose of this letter is to request that a model study of Geneva-on-the-Lake Small-Boat Harbor be scheduled for accomplishment by the Waterways Experiment Station.

2. A small-boat harbor at Geneva-on-the-Lake, Ohio, as set forth in House Document No. 91-402, was authorized for construction under Section 201 of the 1965 Flood Control Act (Public Law 89-298) by Resolutions dated 15 December 1970 and 17 December 1970, respectively. Funds to initiate Advanced Engineering and Design of the project were appropriated in Fiscal Year 1978.

3. Geneva-on-the-Lake, as shown on Plate 1, is located on the south shore of Lake Erie, 17 miles east of Fairport Harbor, Ohio, and 12 miles west of Ashtabula Harbor, Ohio, both of which are Federally improved deep-draft harbors. Geneva-on-the-Lake was identified as a promising location for a small-boat harbor and a harbor-of-refuge because of its strategic location within the boundaries of a State recreational park which is presently being developed by the State of Ohio, its strategic location with respect to existing harbors, its proximity to productive fishing grounds and the appreciable boating demand within the tributary area. Plate 2 shows the existing and proposed recreational development at Geneva State Park.

4. The project, as authorized, will provide a small-boat harbor and harbor-of-refuge and recreational fishing facilities as an integral part of the State Park at Geneva-on-the-Lake. The plan recommended in House Document No. 91-402, and shown on Plate 3, would provide for:

a. Breakwaters in Lake Erie aggregating about 1,400 feet in length, with a riprapped spending beach between the entrance channel and the inner end of the west breakwater;

*EXHIBIT E-4*

b. An entrance channel about 1,000 feet long and varying from 180 to 100 feet in width, eight feet deep for the outer 500 feet and six feet deep for the inner, extending from the eight-foot depth in the lake into the dock channel;

c. A dock channel, 100 feet wide, 1,500 feet in length, and six feet deep, widened to 200 feet at the junction with the entrance channel; and

d. Development of recreational facilities.

5. A Reformulation Phase I GDM was initiated by the Buffalo District in October 1977. The purpose of this Phase I study is to reaffirm the viability of the plan presented in House Document No. 91-402, to develop a modified plan, or to recommend an entirely different plan (including "no action"), if a different plan more nearly satisfies the criteria of engineering, environmental, economic, social, and political feasibility. The Phase I Study will investigate a wide range of alternatives which encompass the changes that have occurred at the proposed harbor site since 1969. These changes, depicted on Plate 4, include: the construction of a parking lot at the location originally proposed for the mooring area, and the establishment of a man-made wetlands area within the location originally proposed for the launching area and turning basin. Alternatives which are currently being investigated include the following: (1) Relocating a portion of the existing parking lot and the wildlife wetlands and constructing the harbor as originally proposed; (2) Constructing a harbor immediately offshore from Geneva State Park; (3) Constructing the harbor to the east in the vicinity of Cowles Creek or west of the originally proposed location; and (4) No action. A preferred alternative plan will be set forth in the Stage II Report (milestone 23) presently scheduled for May 1979.

6. On the basis of experience at other localities, I consider that a model study of the harbor is necessary as an early item in the advanced planning stage. The purpose of the model study would be to determine: the most economical breakwater orientation that will provide a satisfactory entrance and suitable protection to berthed boats; the most effective type of construction; the effects of the structures on the littoral processes; expected wave heights outside and inside the harbor; and any adverse ice conditions which may occur due to configuration of the breakwaters.

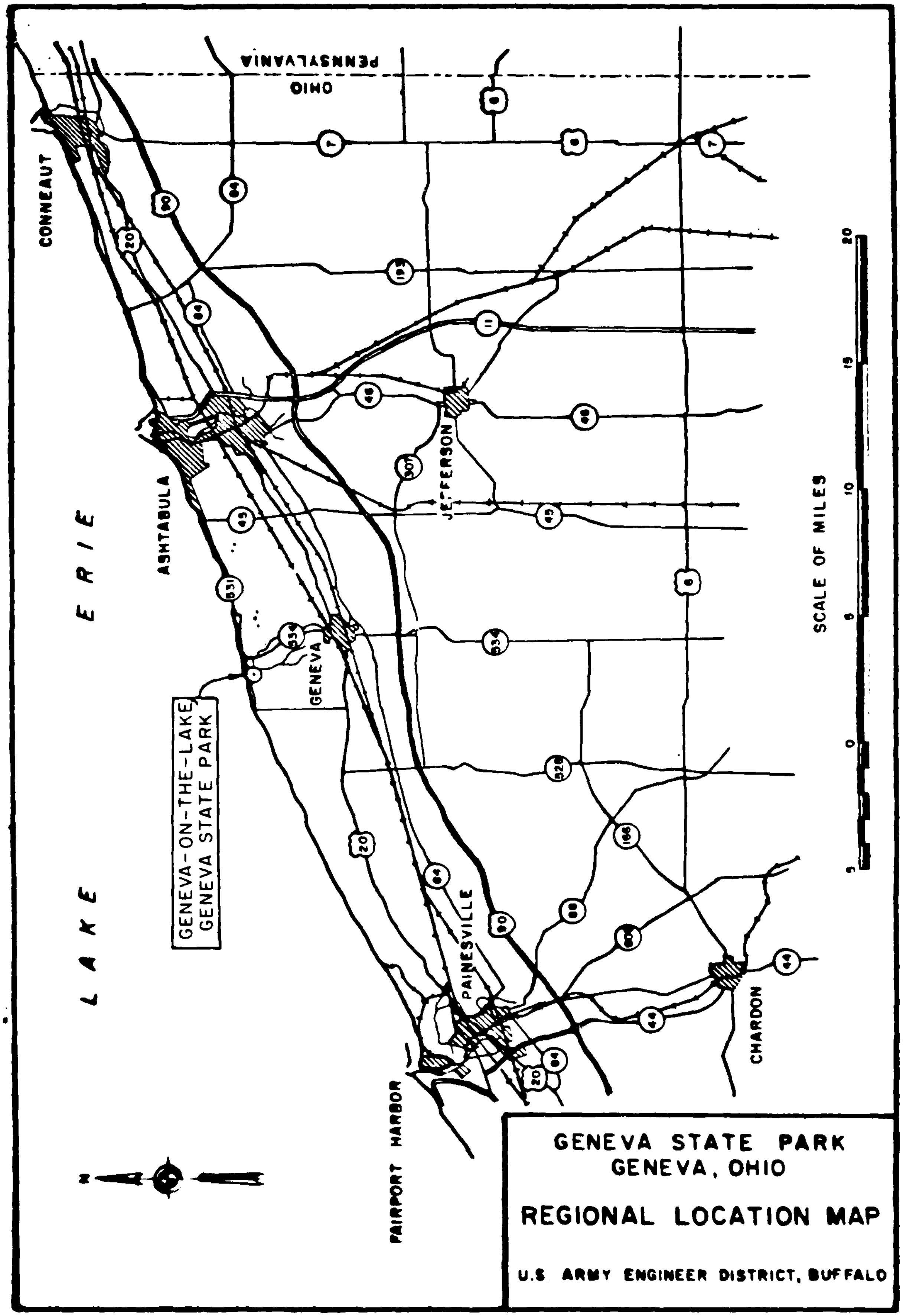
NCBED-PW
SUBJECT: Proposed Model Study of Geneva-on-the-Lake, Ohio,
Small-Boat Harbor

7. In accordance with the procedure for initiating hydraulic model studies as contained in ER 1110-1-8100, paragraph 9a(3), I request authority to have the model study performed starting in September 1979, and I request that the Waterways Experiment Station furnish an estimate of the cost and schedule to conduct the study.

Daniel D. Ludwig

4 incl
as

DANIEL D. LUDWIG
Colonel, Corps of Engineers
District Engineer

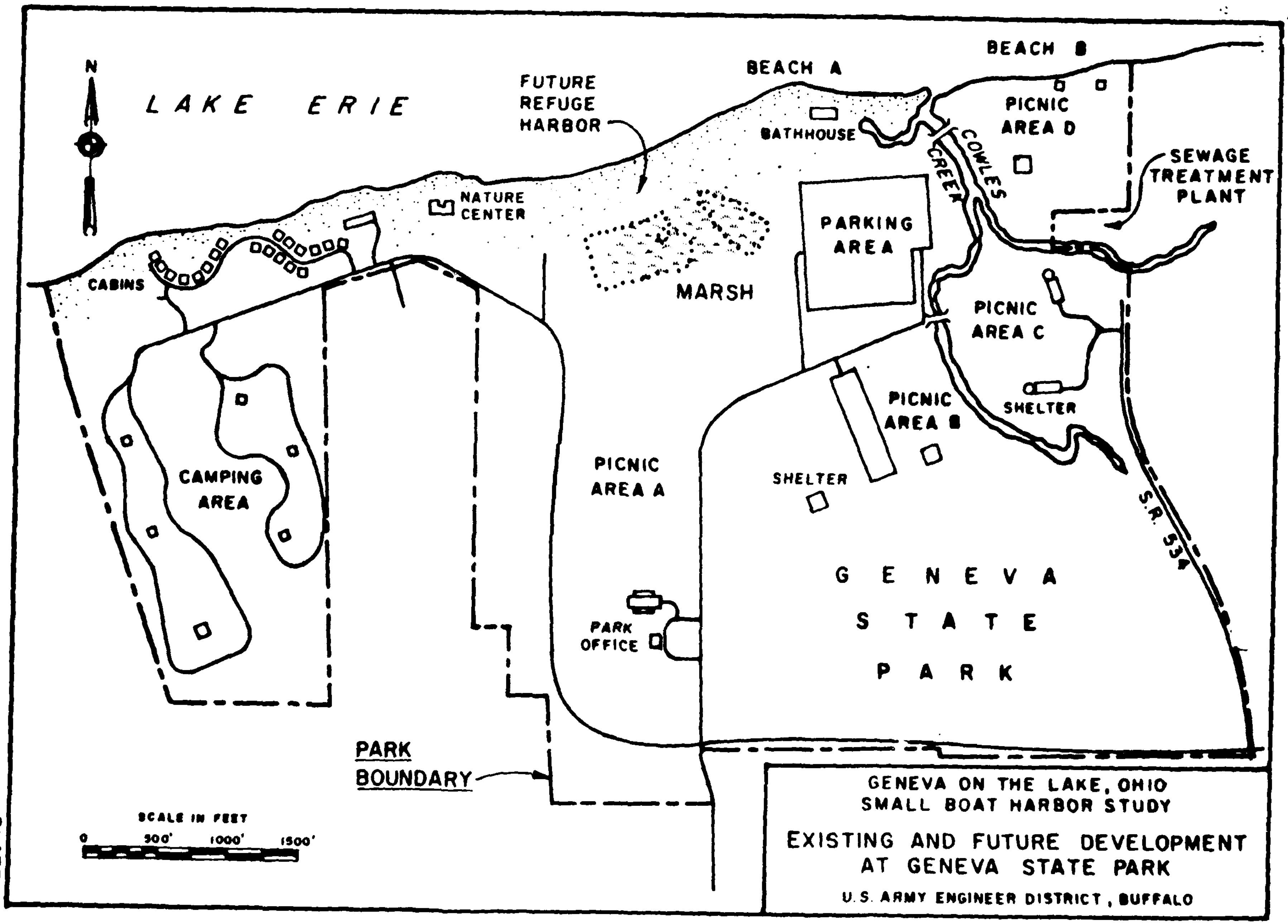



GENEVA STATE PARK
GENEVA, OHIO

REGIONAL LOCATION MAP

U.S. ARMY ENGINEER DISTRICT, BUFFALO

PLATE 1




GENEVA ON THE LAKE, OHIO
SMALL BOAT HARBOR STUDY

EXISTING AND FUTURE DEVELOPMENT
AT GENEVA STATE PARK

U.S. ARMY ENGINEER DISTRICT, BUFFALO

PLATE 2

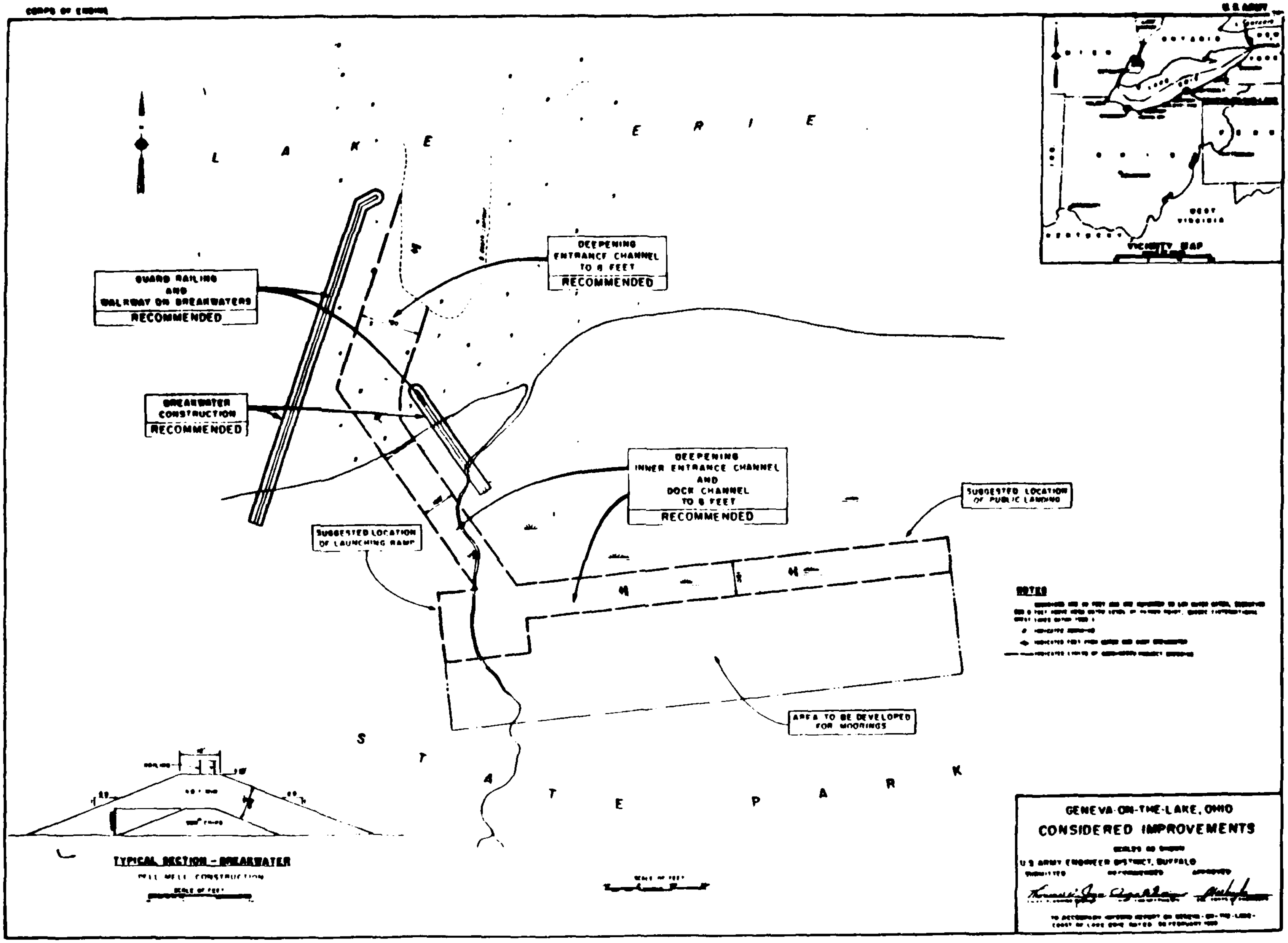
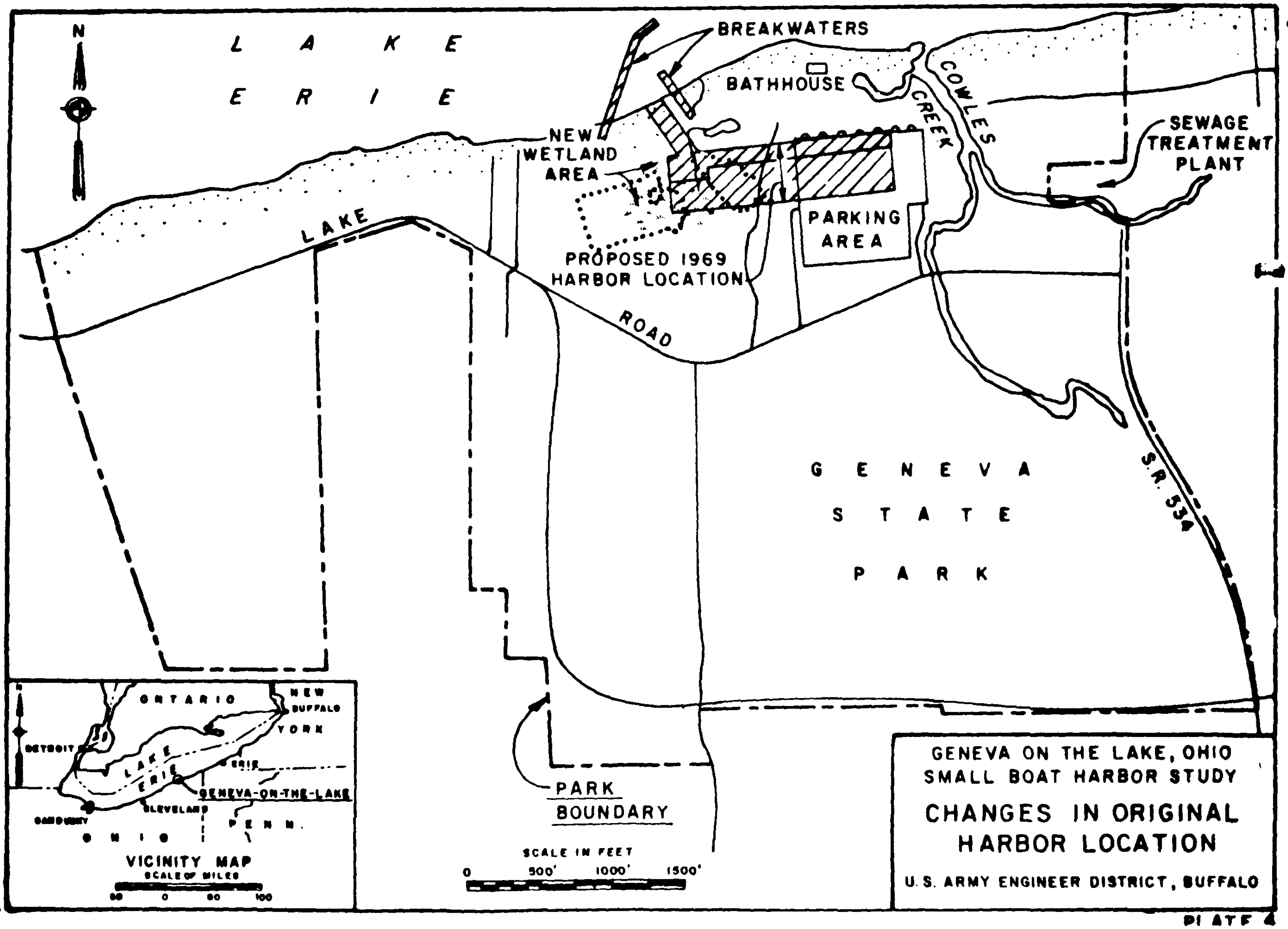

LAKE ERIE
STATE PARK
GUARD RAILING AND WALKWAY ON BREAKWATERS
RECOMMENDED
BREAKWATER CONSTRUCTION
RECOMMENDED
DEEPENING ENTRANCE CHANNEL TO 8 FEET
RECOMMENDED
DEEPENING INNER ENTRANCE CHANNEL AND DOCK CHANNEL TO 8 FEET
RECOMMENDED
SUGGESTED LOCATION OF LAUNCHING RAMP
SUGGESTED LOCATION OF PUBLIC LANDING
AREA TO BE DEVELOPED FOR MOORINGS
NOTES
VICINITY MAP
WEST VIRGINIA
TYPICAL SECTION - BREAKWATER
PELL MELL CONSTRUCTION
GENEVA-ON-THE-LAKE, OHIO
CONSIDERED IMPROVEMENTS
U.S. ARMY ENGINEER DISTRICT, BUFFALO

Plate 3



N
LAKE ERIE
BREAKWATERS
BATHHOUSE
COWLES CREEK
SEWAGE TREATMENT PLANT
NEW WETLAND AREA
PARKING AREA
PROPOSED 1969 HARBOR LOCATION
LAKE ROAD
S.R. 534
GENEVA STATE PARK
PARK BOUNDARY
SCALE IN FEET
0 500' 1000' 1500'
ONTARIO
NEW YORK
BUFFALO
DETROIT
LAKE ERIE
ERIE
GENEVA-ON-THE-LAKE
CLEVELAND
SANDUSKY
OHIO
PENN.
VICINITY MAP
SCALE OF MILES
50 0 50 100
GENEVA ON THE LAKE, OHIO
SMALL BOAT HARBOR STUDY
CHANGES IN ORIGINAL HARBOR LOCATION
U.S. ARMY ENGINEER DISTRICT, BUFFALO
PLATE 4


PLATE 4

6 Mar 1979

NCDED-C (8 Feb 79)
SUBJECT: Proposed Model Study of Geneva-on-the-Lake, Ohio,
Small-Boat Harbor

DA, North Central Division, Corps of Engineers, 536 South Clark Street,
Chicago, Illinois 60605

TO: Commander and Director, Waterways Experiment Station

1. The basic letter is forwarded concurring with the District Engineer's request that WES furnish a cost estimate and schedule for the proposed model study.

2. At this time it is requested that WES provide an approximate cost estimate for modelling each of the alternatives currently being investigated as described in the basic letter. Preliminary draft layouts of the alternative harbor locations are being provided under separate cover. The preferred plan for actual model testing will be selected in May 1979. The specifics of the proposed Geneva-on-the-Lake Harbor model study such as location of the entrance, breakwater configurations, and basin and mooring area configurations relative to various combinations of water levels and wave heights will be discussed with WES in May after the preferred location for the harbor is determined. These discussions will enable WES to develop its final cost estimate with a better understanding of the harbor alternative which must be tested.

FOR THE DIVISION ENGINEER:

DONALD J. LEONARD
Acting Chief, Engineering Division

5 Incl
Added 1 Incl
5. Pre. Hbr layouts (fwd sep)

Copies furnished:
DE, Buffalo, w/o incl

WESHH (8 Feb 79) 2d Ind
SUBJECT: Proposed Model Study of Geneva-on-the-Lake, Ohio, Small-Boat Harbor

USAE Waterways Experiment Station, Vicksburg, MS 39180 22 Mar 79

TO: Division Engineer, U. S. Army Engineer Division, North Central, 536 South Clark Street, Chicago, Illinois 60605

1. The basic letter and its inclosures have been reviewed, and we concur with the District Engineer's recommendation that a hydraulic model study be conducted to optimize design of the proposed small-boat harbor at Geneva-on-the-Lake. Such a study is the only reliable means of determining the most economical location, orientation, length, height, and type of structures required to provide satisfactory entrance and berthing conditions.

2. As requested, time and cost estimates for the subject study are as follows:

| Item | Time (months) | Cost |
|---|---|---|
| Model design | 1 | $ 8,000 |
| Model construction | 2 | 50,000 |
| Model testing: | | |
| Existing conditions | 1 | 10,000 |
| Alternative #1 | 1 | 10,000 |
| Alternative #2 | 1 | 10,000 |
| Alternative #3 | 1 | 10,000 |
| Alternative #4 | 1 | 10,000 |
| Data analysis, conferences, travel, misc. | 1 | 10,000 |
| Final report: | | |
| Draft copy | 2 | 4,000 |
| Published copy | 4 | 2,000 |
| TOTALS | 15 | $124,000 |

3. If only one alternative is selected for testing in the model, it is suggested that one additional month and $10,000 be allowed for testing modifications to that basic plan. The total time then required would be 13 months and the total cost would be $104,000.

4. The above estimates are based on a model scale of about 1:50 (due to the shallow depths involved) and reproducing the proposed harbor area, the lower reaches of Cowles Creek, about 6000 ft of shoreline, and lakeward contours to about -30 ft.

WESHH (8 Feb 79) 2d Ind 22 March 1979
SUBJECT: Proposed Model Study of Geneva-on-the-Lake, Ohio, Small-Boat Harbor

5. Based on our current and projected workload, it is estimated that model design could be accomplished in September 1979 and model construction initiated during the first quarter of FY 80. If your office has any questions regarding the above estimates, please call Mr. C. E. Chatham (FTS 542-2460) directly.

FOR THE COMMANDER AND DIRECTOR:

4 Incl
1-4. nc
wd Incl 5

F. R. BROWN
Engineer
Technical Director

CF w/o incl:
NCB

NCDED-C (8 Feb 79) 3rd Ind
SUBJECT: Proposed Model Study of Geneva-on-the-Lake, Ohio, Small-Boat Harbor

DA, North Central Division, Corps of Engineers, 536 South Clark Street, Chicago, Illinois 60605 28 MAR 1979

TO: District Engineer, Buffalo

1. Forwarded for your review are WES's time and cost estimates for conducting the subject model study.

2. If the District Engineer wishes to request the subject model study, WESHH comments, recommendations, and cost estimates should be returned with the request to Division Engineer, ATTN: NCDED-C. This office will then forward the District Engineer's request to HQDA for approval in accordance with ER 1110-1-8100, para 9. a. (3).

3. It is recommended that following determination of the preferred harbor alternative and approval to conduct the model study, a meeting with Buffalo District and Division personnel be held at WES to discuss the specifics of the harbor alternative to be tested. This meeting will provide WES with a better understanding of our modeling requirements.

FOR THE DIVISION ENGINEER:

4 Incl
nc

DONALD J. LEONARD
Acting Chief, Engineering Division

Copy furnished:
WESHH
w/o incl

**DEPARTMENT OF THE ARMY**
**BUFFALO DISTRICT, CORPS OF ENGINEERS**
**1776 NIAGARA STREET**
**BUFFALO, NEW YORK 14207**

NCBED-PW 18 April 1979

SUBJECT: Proposed Model Study of Geneva-on-the-Lake, Ohio, Small-Boat Harbor

Division Engineer, North Central
ATTN: NCDED-C

1. The purpose of this letter is to request approval to conduct a model study of the Geneva-on-the-Lake small-boat harbor.

2. A small-boat harbor at Geneva-on-the-Lake, Ohio, as set forth in House Document No. 91-402, was authorized for construction under Section 201 of the 1965 Flood Control Act (Public Law 89-298) by the House and Senate Committees on Public Works by Resolutions dated 15 December 1970 and 17 December 1970, respectively. Funds to initiate Advanced Engineering and Design of the project were appropriated in Fiscal Year 1978.

3. Geneva-on-the-Lake, as shown on Plate 1, is located on the south shore of Lake Erie, 17 miles east of Fairport Harbor, Ohio, and 12 miles west of Ashtabula Harbor, Ohio, both of which are Federally improved deep-draft harbors. Geneva-on-the-Lake was identified as a promising location for a small-boat harbor and a harbor-of-refuge because of its strategic location within the boundaries of a State recreational park which is presently being developed by the State of Ohio, its strategic location with respect to existing harbors, its proximity to productive fishing grounds and the appreciable boating demand within the tributary area. Plate 2 shows the existing and proposed recreational development at Geneva State Park.

4. The project, as authorized, will provide a small-boat harbor and harbor-of-refuge and recreational fishing facilities as a integral part of the State Park at Geneva-on-the-Lake. The plan recommended in House Document No. 91-402, and shown on Plate 3, would provide for:

a. Breakwaters in Lake Erie aggregating about 1,400 feet in length, with a riprapped spending beach between the entrance channel and the inner end of the west breakwater;

EXHIBIT E-5

b. An entrance channel about 1,000 feet long and varying from 180 to 100 feet in width, eight feet deep for the outer 500 feet and six feet deep for the inner, extending from the eight-foot depth in the lake into the dock channel;

c. A dock channel, 100 feet wide, 1,500 feet in length, and six feet deep, widened to 200 feet at the junction with the entrance channel; and

d. Development of recreational facilities.

5. A Reformulation Phase I GDM was initiated by the Buffalo District in October 1977. The purpose of this Phase I study is to reaffirm the viability of the plan presented in House Document No. 91-402, to develop a modified plan, or to recommend an entirely different plan (including "no action"), if a different plan more nearly satisfies the criteria of engineering, environmental, economic, social, and political feasibility. The Phase I Study will investigate a wide range of alternatives which encompass the changes that have occurred at the proposed harbor site since 1969. These changes, depicted on Plate 4, include: the construction of a parking lot at the location originally proposed for the mooring area; and the establishment of a man-made wetlands area within the location originally proposed for the launching area and turning basin.

6. Buffalo District is currently investigating four alternative harbor layouts: (1) an offshore harbor; (2) a harbor in the vicinity of Cowles Creek; (3) a harbor to the west of the parking lot; and (4) a harbor partially within the wetlands area and the north half of the existing parking lot. Following discussions with the Ohio Department of Natural Resources, the local sponsor for the project, and the U.S. Fish and Wildlife Service, a preferred alternative plan will be selected and set forth in the Stage II Report (milestone 23) presently scheduled for May 1979.

7. On the basis of experience at other localities, I consider that a model study of the harbor is necessary as an early item in the advanced planning stage. The purpose of the model study would be to determine: the most economical breakwater orientation that will provide a satisfactory entrance and suitable protection to berthed boats; the most effective type of construction; the effects of the structures on the littoral processes; expected wave heights outside and inside the harbor; and any adverse ice conditions which may occur due to configuration of the breakwaters.

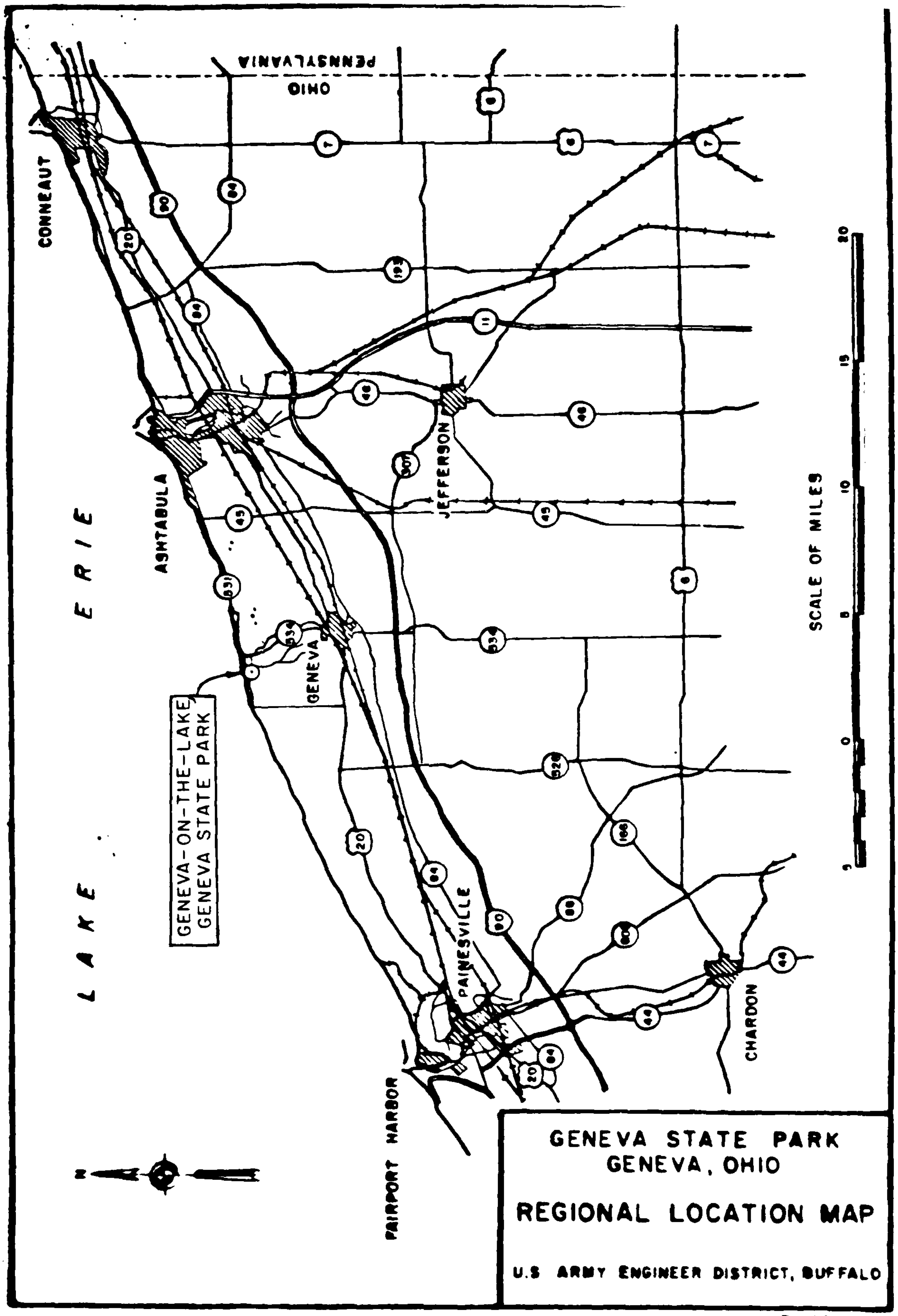
NCBED-PW
SUBJECT: Proposed Model Study of Geneva-on-the-Lake, Ohio, Small-Boat Harbor

8. The Waterways Experiment Station has submitted a time and cost estimate for the proposed model study as shown in Inclosure 5. As indicated in paragraph 3, the cost for testing one alternative, including one month for testing modifications to the basic plan is $104,000 and would require 13 months to complete. Subsequent discussions with WES have modified this original estimate to include an additional two months and $20,000 for testing modifications to the basic plan. Therefore, the total cost of the model study for one alternative, including three months and $30,000 for testing modifications to the basic plan, is $124,000 and would require 15 months to complete.

9. In accordance with the procedure for initiating hydraulic model studies as contained in ER 1110-1-8100, paragraph 9a(3), I request authority to have a model study of the Geneva-on-the Lake small-boat harbor performed by the Waterways Experiment Station. Funds for this model study would be expended in FY 79, FY 80, and FY 81.

5 Incl
as

THOMAS R. BRAUN
LTC, Corps of Engineers
Acting District Engineer

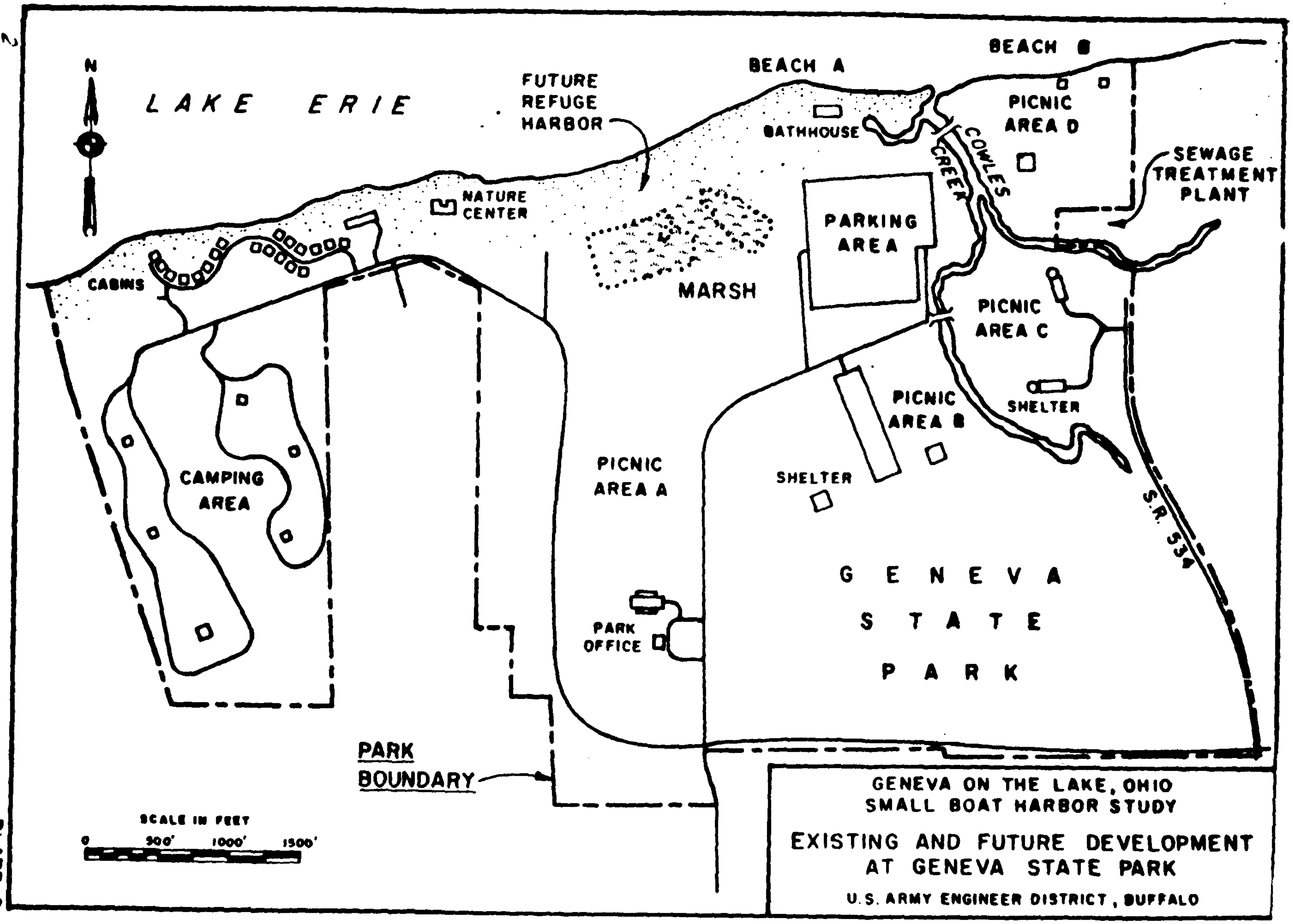



GENEVA STATE PARK
GENEVA, OHIO

REGIONAL LOCATION MAP

U.S ARMY ENGINEER DISTRICT, BUFFALO

PLATE I


N
LAKE ERIE
FUTURE REFUGE HARBOR
BEACH A
BEACH B
BATHHOUSE
COWLES CREEK
PICNIC AREA D
SEWAGE TREATMENT PLANT
NATURE CENTER
CABINS
MARSH
PARKING AREA
PICNIC AREA C
PICNIC AREA B
SHELTER
SHELTER
PICNIC AREA A
CAMPING AREA
PARK OFFICE
GENEVA STATE PARK
S.R. 534
PARK BOUNDARY
SCALE IN FEET
0 500' 1000' 1500'
GENEVA ON THE LAKE, OHIO
SMALL BOAT HARBOR STUDY
EXISTING AND FUTURE DEVELOPMENT
AT GENEVA STATE PARK
U.S. ARMY ENGINEER DISTRICT, BUFFALO
PLATE 2

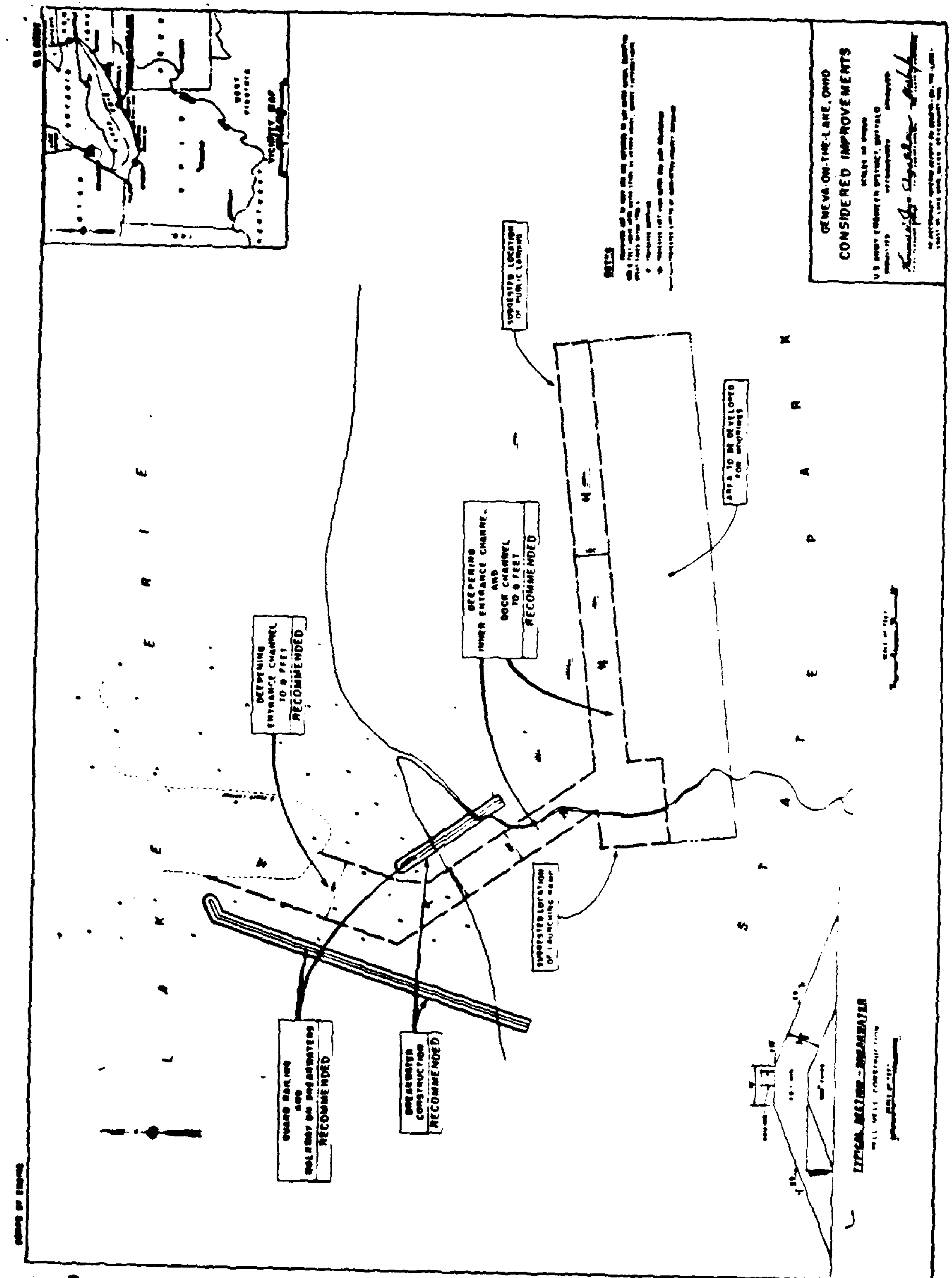

GENEVA-ON-THE-LAKE, OHIO
CONSIDERED IMPROVEMENTS
VICINITY MAP
L A K E E R I E
S T A T E P A R K
DEEPENING ENTRANCE CHANNEL TO 8 FEET RECOMMENDED
DEEPENING INNER ENTRANCE CHANNEL AND DOCK CHANNEL TO 8 FEET RECOMMENDED
GUARD RAILING AND WALKWAY ON BREAKWATERS RECOMMENDED
BREAKWATER CONSTRUCTION RECOMMENDED
SUGGESTED LOCATION OF PUBLIC LANDING
SUGGESTED LOCATION OF LAUNCHING RAMP
TYPICAL SECTION - BREAKWATER

Plate 3

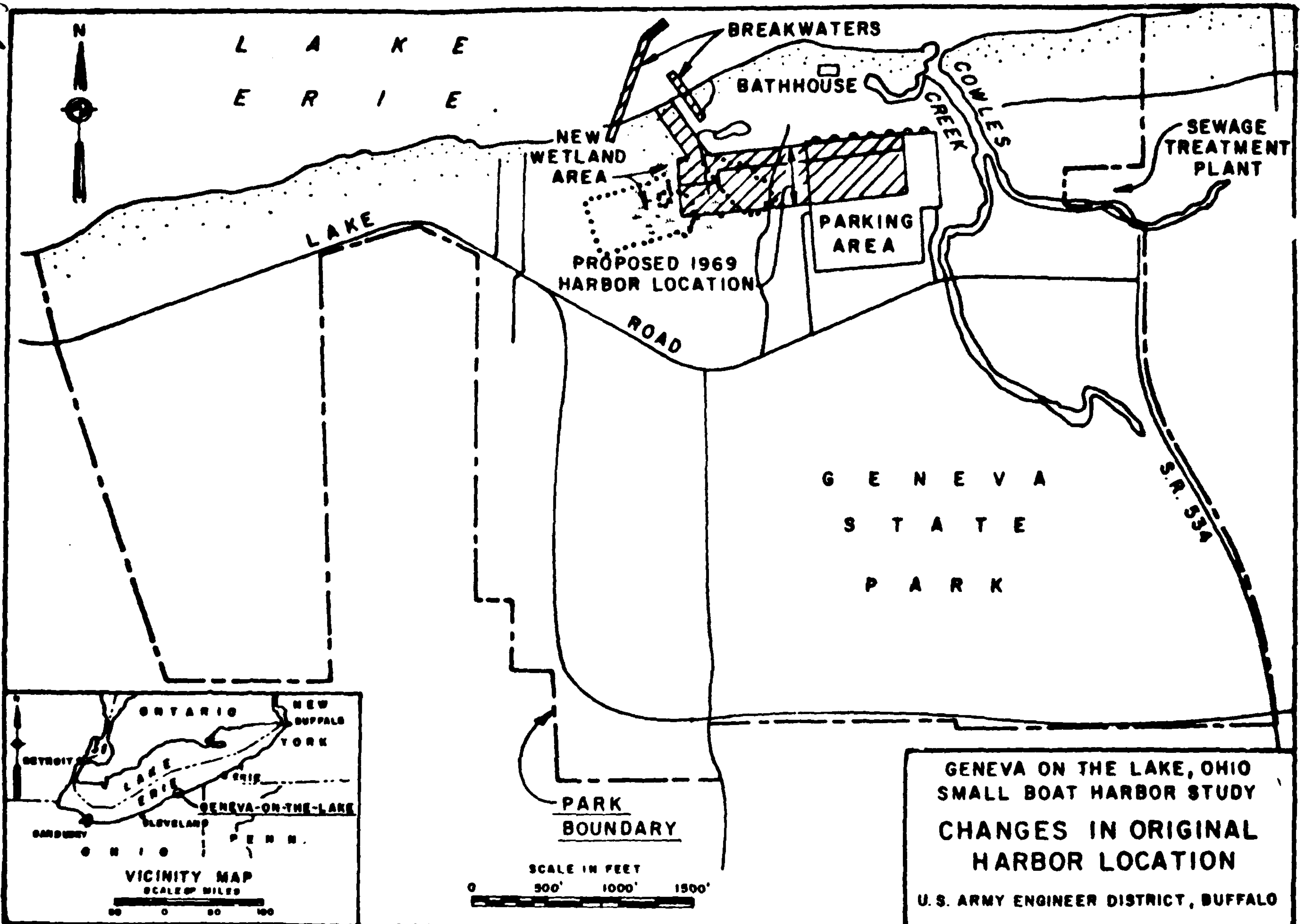

N
LAKE ERIE
BREAKWATERS
BATHHOUSE
NEW WETLAND AREA
PROPOSED 1969 HARBOR LOCATION
COWLES CREEK
SEWAGE TREATMENT PLANT
PARKING AREA
LAKE ROAD
S.R. 534
GENEVA STATE PARK
PARK BOUNDARY
SCALE IN FEET
0 500' 1000' 1500'
ONTARIO
NEW YORK
BUFFALO
DETROIT
LAKE ERIE
ERIE
GENEVA-ON-THE-LAKE
CLEVELAND
SANDUSKY
OHIO
PENN.
VICINITY MAP
SCALE OF MILES
50 0 50 100
GENEVA ON THE LAKE, OHIO
SMALL BOAT HARBOR STUDY
CHANGES IN ORIGINAL
HARBOR LOCATION
U.S. ARMY ENGINEER DISTRICT, BUFFALO

PLATE 4

WESHH (8 Feb 79) 2d Ind
SUBJECT: Proposed Model Study of Geneva-on-the-Lake, Ohio, Small-Boat Harbor

USAE Waterways Experiment Station, Vicksburg, MS 39180 22 Mar 79

TO: Division Engineer, U. S. Army Engineer Division, North Central, 536 South Clark Street, Chicago, Illinois 60605

1. The basic letter and its inclosures have been reviewed, and we concur with the District Engineer's recommendation that a hydraulic model study be conducted to optimize design of the proposed small-boat harbor at Geneva-on-the-Lake. Such a study is the only reliable means of determining the most economical location, orientation, length, height, and type of structures required to provide satisfactory entrance and berthing conditions.

2. As requested, time and cost estimates for the subject study are as follows:

| Item | Time (months) | Cost |
|---|---|---|
| Model design | 1 | $ 8,000 |
| Model construction | 2 | 50,000 |
| Model testing: | | |
| Existing conditions | 1 | 10,000 |
| Alternative #1 | 1 | 10,000 |
| Alternative #2 | 1 | 10,000 |
| Alternative #3 | 1 | 10,000 |
| Alternative #4 | 1 | 10,000 |
| Data analysis, conferences, travel, misc. | 1 | 10,000 |
| Final report: | | |
| Draft copy | 2 | 4,000 |
| Published copy | 4 | 2,000 |
| TOTALS | 15 | $124,000 |

3. If only one alternative is selected for testing in the model, it is suggested that one additional month and $10,000 be allowed for testing modifications to that basic plan. The total time then required would be 13 months and the total cost would be $104,000.

4. The above estimates are based on a model scale of about 1:50 (due to the shallow depths involved) and reproducing the proposed harbor area, the lower reaches of Cowles Creek, about 6000 ft of shoreline, and lakeward contours to about -30 ft.



Incl 5

WESHH (8 Feb 79) 2d Ind 22 March 1979
SUBJECT: Proposed Model Study of Geneva-on-the-Lake, Ohio, Small-Boat Harbor

5. Based on our current and projected workload, it is estimated that model design could be accomplished in September 1979 and model construction initiated during the first quarter of FY 80. If your office has any questions regarding the above estimates, please call Mr. C. E. Chatham (FTS 542-2460) directly.

FOR THE COMMANDER AND DIRECTOR:

4 Incl
1-4. nc
wd Incl 5

for F. R. BROWN
Engineer
Technical Director

CF w/o incl:
NCB

NCDED-C (18 April 1979) 1st Ind
SUBJECT: Proposed Model Study of Geneva-on-the-Lake,
Ohio, Small-Boat Harbor

DA, North Central Division, Corps of Engineers, 536 South Clark Street,
Chicago, Illinois 60605 25 APR 1979

TO: HQDA (DAEN-CWE-H) WASH DC 20314

It is recommended that the proposed model study be approved at a total cost of $124,000. WES's recommendations and time and cost estimate are attached to the basic letter. Funds in the amount of $8,000 are available in the Buffalo District to initiate model design work in FY 1979. Construction of the model will be accomplished in FY 1980.

FOR THE DIVISION ENGINEER:

Lee R. Hoglind

5 Incl
nc

LEE R. HOGLIND
Acting Chief, Engineering Division

Copy Furnished:
DE, Buffalo, w/cy basic

DAEN-CWE-HD (18 Apr 79) 2nd Ind
SUBJECT: Proposed Model Study of Geneva-on-the-Lake, Ohio, Small-
Boat Harbor

DA, Office of the Chief of Engineers, Washington, DC 20314 7 May 1979

TO: Division Engineer, North Central
ATTN: NCDED-C

Approved.

FOR THE CHIEF OF ENGINEERS:

5 Incl
nc

for JACK R. THOMPSON
Acting Chief, Engineering Division
Directorate of Civil Works

NCDED-W (18 Apr 79) 3rd Ind
SUBJECT: Proposed Model Study of Geneva-on-the-Lake, Ohio, Small-Boat Harbor

DA, North Central Division, Corps of Engineers, 536 South Clark Street, Chicago, Illinois 60605 15 MAY 1979

TO: District Engineer, Buffalo

Referred.

FOR THE DIVISION ENGINEER:

5 Incl
nc

Lee R. Hoglind
LEE HOGLIND
Acting Chief, Engineering Division

**Regional Office: Cleveland Museum of Natural History**
**Wade Oval University Circle Cleveland, Ohio 44106 (216) 231-4600**

November 3, 1978

Daniel D. Ludwig, PE
Colonel, Corps of Engineers
Department of the Army
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Mr. Ludwig,

This is in response to your letter of October 23, 1978, requesting information on the cultural resources in the proposed study area of the Geneva State Park, Geneva-On-The-Lake, Ohio.

No known archaeological properties are recorded within the proposed study area. However, the inventory of archaeological resources, both historic and archaeological, in the proposed project area is incomplete. At this time it is not possible to provide you with a complete listing of resources. Naturally we are most concerned about any new construction which affects previously undisturbed land (including farmland), because of its potential for affecting known and presently unknown archaeological sites.

An archaeological survey of the project area would have to be completed before an authoritative assessment of the effects of the proposed project can be determined. It is our recommendation that an archaeological survey be completed before any land alteration is undertaken in this region.

May I also recommend that Eric Johannesen (Regional Historic Preservationist) be contacted at the Western Reserve Historical Society for further information concerning historic properties within the project area. If you have any questions regarding this matter, please feel free to contact me.

Sincerely,

David R. Bush
Regional Archaeological Preservationist

DRB/cc
cc: Eric Johannesen

EXHIBIT E-6

**Ohio Historic Preservation Office**
**Ohio Historical Center I-71 & 17th Avenue Columbus, Ohio 43211 (614) 466-8727**

| TELEPHONE OR VERBAL CONVERSATION RECORD<br>For use of this form, see AR 340-15; the proponent agency is The Adjutant General's Office. | | DATE<br>14 November 1978 |
|---|---|---|
| SUBJECT OF CONVERSATION<br>Requests for Cultural Resources Information on Lorain Harbor and Geneva-on-the-Lake | | |
| INCOMING CALL | | |
| PERSON CALLING<br>Peter Dilworth | ADDRESS<br>HCRS, Ann Ar or, Mich. | PHONE NUMBER AND EXTENSION<br>FTS 378-2028 |
| PERSON CALLED<br>Phil Berkeley | OFFICE<br>NCBED-PE | PHONE NUMBER AND EXTENSION<br>x2175 |
| OUTGOING CALL | | |
| PERSON CALLING | OFFICE | PHONE NUMBER AND EXTENSION |
| PERSON CALLED | ADDRESS | PHONE NUMBER AND EXTENSION |

SUMMARY OF CONVERSATION

1. Peter Dilworth of the HCRS in Ann Arbor, Michigan called about a set of recent letters received from the Buffalo District requesting cultural resources information from their files on the proposed Lorain Harbor study and the Geneva-on-the-Lake Small Boat Harbor study.

2. He indicated that they had no information available. The District may receive a letter from their office indicating the above fact.

EXHIBIT E-7

United States Department of the Interior

IN REPLY REFER TO:

FISH AND WILDLIFE SERVICE
Division of Ecological Services
Columbus Field Office
3990 East Broad Street
Columbus, Ohio 43215

July 2, 1979

Mr. Ronald M. Liddell
Chief, Engineering Division
U.S. Army Engineer District
Buffalo
1776 Niagara Street
Buffalo, New York 14207

Dear Mr. Liddell:

The U.S. Fish and Wildlife Service has reviewed your letter of June 13, 1979, presenting the Buffalo District's interpretation of Executive Order 11990 as it relates to evaluation of the four alternative harbor plars for Geneva-State Park.

We agree with your position that construction of Alternative #4 would be in violation of Executive Order 11990 as practical alternatives do exist. However, we would request that Alternative # 1 continue to be considered as a practical alternative for the following reasons:

1. Alternative # 1 does have a favorable B/C ratio.

2. While Alternative # 1 would seperate the bathhouse from the beach east of Cowles Creek, it would be the only alternative that would create and maintain a natural beach directly lakeward of the bathhouse. All other alternatives would result in erosion directly lakeword of the bathhouse, requiring a sand by-pass system and additional shoreline protection similar to that that would be required east of Cowles Creek for Alternative # 1. A large beach formed or maintained by a breakwater at Cowles Creek would reduce the necessity of having a second beach east of Cowles Creek. Bathers still desiring to use the east beach could use the bathhouse facilities presently available on the east side of Cowles Creek. The land isolated between the harbor channel and Cowles Creek could be utilized as a beach by the boaters. If the foot bridge were not removed, the boaters would have ready access to the picnic area east of Cowles Creek.

3. There does not appear to have been coordination between the shoreline erosion control needs at Geneva State Park, the design of the harbor, and the reestablishment of a bathing beach. The total costs and benefits of harbor construction, associated erosion control, beach protection and maintenance, and mitigation of environmental impacts should be considered together. When they are, Alternative # 1 may have the lowest total cost of the harbor designs being considered.

EXHIBIT E-8

4. Alternative # 1 would be the only alternative that would not interrupt direct access along the beach from the bathhouse and associated parking lot to the nature center to be built west of the wetland area.

5. While Alternative # 1 does juxtapose a harbor entrance and swimming beaches, we do not believe that it poses a significantly higher risk of boat-swimmer collisions than that posed by the other alternative harbor layouts. All alternatives would have the harbor entrance within approximately one quarter mile or less of the swimming beaches.

6. While the entrance channel for Alternative # 1 does involve a slight turn, we believe that the design criterium width of 100 feet provides adequate clearance for a safe entrance to the harbor even during storms.

7. We believe that the amount of parking lot lost due to construction of Alternative # 1 might be reduced if the harbor basin can be located slightly closer to the lake. There is also additional parking available south of the bathhouse parking lot on the south side of Lake Road. Finally, additional parking lanes could be constructed on the west side of the parking lot in the vicinity of the marina under alternative # 2, or immediately south of the main parking lot.

8. Alternative # 1 appears at this time to involve the least direct and indirect impacts upon the wetland areas and would probably involve the lowest cost for mitigation of environmental impacts.

9. The potential for fishery resource enhancement appears to be higher for Alternative # 1 than for the other alternatives. A significant number of salmonids stocked in Arcola Creek appear to stray to Cowles Creek during their homing migration. The breakwaters associated with Alternative # 1 may provide increased access to this salmonid fishery in addition to providing spawning, nursery, and feeding areas for some of the fish species indigenous to Cowles Creek.

Regarding the other alternatives, Alternative # 2 has a favorable B/C ratio and avoids the major portions of the wetland. A water control structure for the wetland may be required. Alternative # 3 has a favorable B/C ratio but impacts the northeast portion of the wetlands. As practical alternatives involving lesser damages to the wetlands exist, we believe that Alternative # 3 should be dropped from further consideration by the Corps.

While these opinions are subject to change based upon data generated during the completion of our four season study, the U.S. Fish and Wildlife Service would recommend at this time that Alternatives # 1 and # 2 continue to be given serious consideration as practical designs subject to future refinement.

Sincerely yours,

Conrad A. Fjetland

Conrad A. Fjetland
Supervisor

cc: Regional Administrator, U.S. EPA, Federal Activities Br., Chicago, IL
Chief, ODNR, Div. of Wildl., Columbus, OH

# United States Department of the Interior

IN REPLY REFER TO:

FISH AND WILDLIFE SERVICE
Division of Ecological Services
Columbus Field Office
3990 East Broad Street
Columbus, Ohio 43215


July 6, 1979

Mr. Ronald M. Liddell
Chief, Engineering Division
U.S. Army Engineer District
Buffalo
1776 Niagara Street
Buffalo, New York 14207

Dear Mr. Liddell:

The following letter provides a modification of the U.S. Fish and Wildlife Service letter of July 2, 1979, to you regarding the harbor alternatives for Geneva State Park.

In addressing Alternative # 1 we had mistakenly interpreted the east limit of the interior federal channel to be the east limit of the harbor. The actual harbor limits were obscured by the various contour lines shown on our monochrome drawings. In light of this discovery, the following sections of our letter of July 2, 1979,should be deleted:

statement # 2 - last two sentences

statement # 7 - first sentence

It appears that the only way to reduce the area of parking lot lost if Alternative # 1 were to be selected would be to modify the Alternative by replacing some of the inshore mooring area with an expanded offshore mooring area.

Sincerely yours,

Conrad A. Fjetland

Conrad A. Fjetland
Supervisor

cc: Regional Administrator, U.S. EPA, Federal Activities Br., Chicago, IL
ODNR, Outdoor Recreation Serv., Attn: Mike Colvin, Columbus, OH

EXHIBIT E-9

ODNR
Ohio Department of Natural Resources
OFFICE OF CHIEF ENGINEER
Fountain Square · Columbus, Ohio 43224 · (614) 466-4633

July 17, 1979

Donald M. Liddell, Chief
Engineering Division
Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Mr. Liddell:

Reference is made to your letters of July 5th and July 13, 1979 regarding the Geneva Small Boat Harbor Project.

We have reviewed the alternatives submitted and have developed several others for your consideration. These two alternatives that we have developed are alterations of alternate #3. The sketches are to be considered preliminary only as further modifications and adjustments may be necessary before finalization. We submit them for your review and consideration.

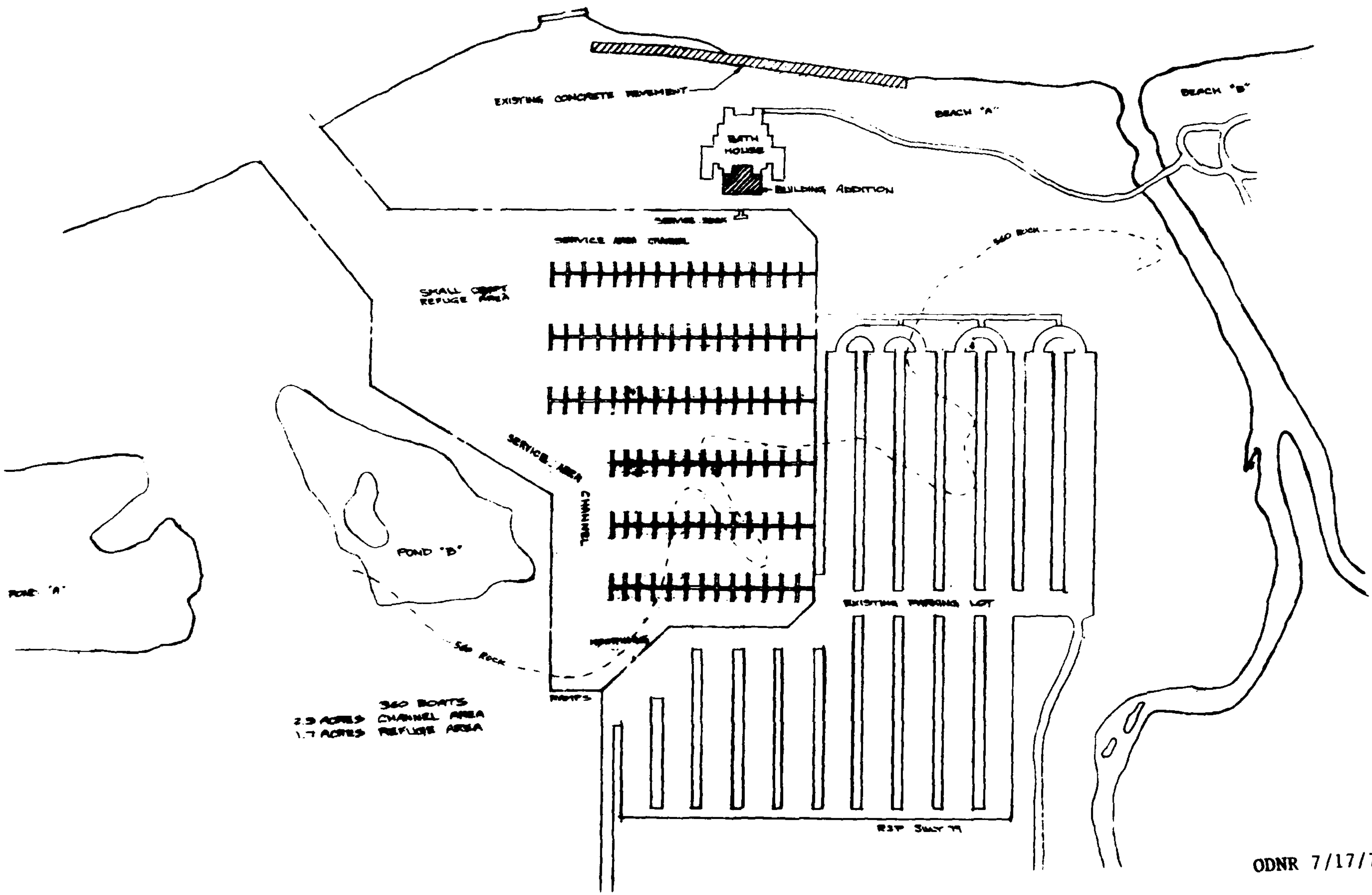
Regarding your position paper on practical alternatives we are somewhat appalled that costs are not considered in arriving at practicality of solutions. Surely the existing marsh must have a monetary value and this should be considered in any cost ratio along with any mitigation measures that may be necessary.

Sincerely,

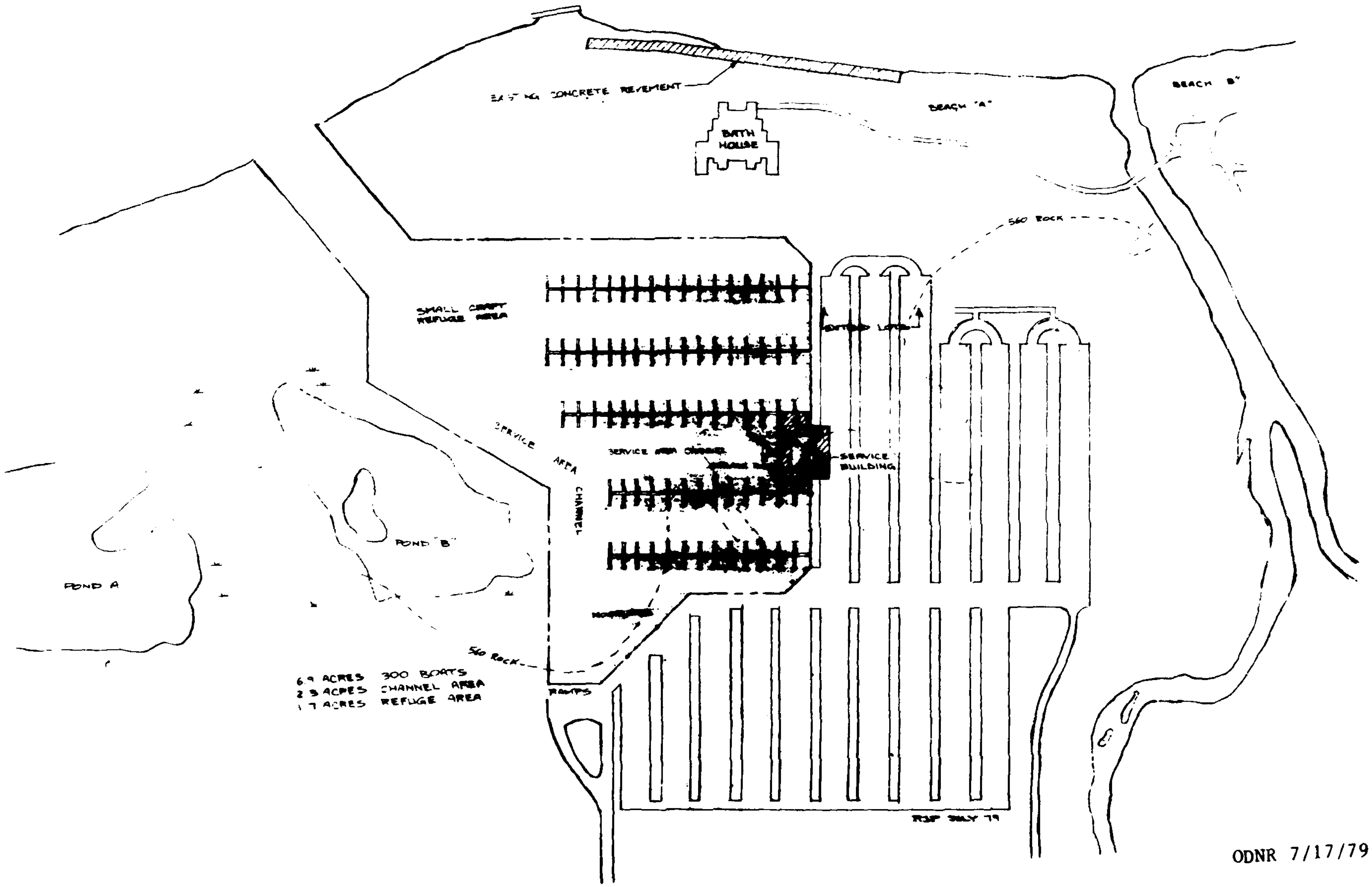
JAMES A. SWARTZMILLER
CHIEF ENGINEER

JAS:bm
cc: Don Olson
Norv Hall

EXHIBIT E-10


EXISTING CONCRETE REVETMENT
BEACH "A"
BEACH "B"
BATH HOUSE
BUILDING ADDITION
SERVICE AREA CHANNEL
SMALL CRAFT REFUGE AREA
SERVICE AREA CHANNEL
POND "B"
EXISTING PARKING LOT
360 BOATS
2.3 ACRES CHANNEL AREA
1.7 ACRES REFUGE AREA

ODNR 7/17/79


EXISTING CONCRETE REVETMENT
BATH HOUSE
BEACH "A"
BEACH "B"
560 ROCK
SMALL CRAFT REFUGE AREA
SERVICE AREA CHANNEL
SERVICE BUILDING
POND "B"
POND A
560 ROCK
RAMPS
6.9 ACRES 300 BOATS
2.3 ACRES CHANNEL AREA
1.7 ACRES REFUGE AREA
RJP JULY 79

ODNR 7/17/79

NCBED-PW 13 June 1979

James A. Swartzmiller, Chief Engineer
Ohio Department of Natural Resources
Fountain Square
Columbus, OH 43224

Dear Mr. Swartzmiller:

As per your request at the Geneva-on-the-Lake Small-Boat Harbor Study workshop meeting on 29 May 1979, the position paper presenting Buffalo District's interpretation of Executive Order 11990 as it relates to evaluation of practical alternatives is provided for your review (Inclosure 1). Plates of the four alternative harbor plans discussed in this paper were previously provided by letter dated 5 June 1979.

Please review the enclosed position paper and provide me with your comments by 2 July 1979 so that alternative selection may be incorporated into the Stage 2 report.

If you have any questions regarding this matter, please contact Mr. Richard Aguglia at (716) 876-5454, extension 2263.

Sincerely yours,

1 Incl
as stated

DONALD M. LIDDELL
Chief, Engineering Division

EXHIBIT E-11

Position Paper on Buffalo District Interpretation of Executive Order 11990 As It Relates to Evaluation of Practical Alternatives for the Geneva-on-the-Lake Small-Boat Harbor Study

1. The feasibility of constructing a small-boat harbor and harbor-of-refuge and recreational fishing facilities as an integral part of the State Park at Geneva-on-the-Lake, Ohio was studied by the Corps of Engineers in 1969. A harbor design was developed and the project was found to be economically justified at that time. The results of the feasibility were published in House Document No. 91-402 and a project was authorized for construction under Section 201 of the 1965 Flood Control Act (Public Law 89-298) by the House and Senate Committees on Public Works by Resolutions dated 15 December 1970 and 17 December 1970, respectively. Funds to initiate the Advanced Engineering and Design of the project were appropriated in Fiscal Year 1978.

2. Several legislative and physical changes, having a direct influence on the feasibility of constructing the authorized project, have occurred since the 1969 Interim Report was submitted to Congress and subsequently authorized for construction. The physical changes, depicted on Plate 1 (Attachment 1), include: the construction of a parking lot at the location originally proposed for the mooring area, and the expansion of an existing wetland area due to construction activities within the location originally proposed for the launching area and turning basin. Legislative actions, such as NEPA, that place increased emphasis on environmental preservation and enhancement, affect the decision on viability of water resources projects such as Geneva-on-the-Lake. Based on these factors, it was concluded that reformulation of the Geneva-on-the-Lake project was necessary. In addition, Executive Order 11990 (Attachment 2), issued 24 May 1977, places increased emphasis on preservation of wetlands. The requirements of Section 2 of the Executive Order provide the basis for our interpretation of the viability of alternative plans for the Geneva-on-the-Lake Small-Boat Harbor Study. A discussion of our interpretation as it relates to each of the four alternatives is presented in para. 4.

3. As part of this Reformulation Phase I GDM, Buffalo District personnel developed eight preliminary harbor layouts for the 18 January 1979 workshop meeting with the Ohio Department of Natural Resources (ODNR), the local sponsor for this project. As a result of this workshop meeting, four preliminary harbor layouts were eliminated from further consideration, and four alternative harbor layouts were identified for further in-depth study. The four alternative harbor layouts that were identified for further study were then developed

Incl 1

in sufficient detail to provide initial choices as to the range of viable resource management options available in the study area. Although the Corps did not develop the detailed engineering or advanced design criteria for each alternative, the alternatives were developed in sufficient detail to: (1) assure the basic engineering soundness of design; (2) identify all major components of each alternative; (3) estimate the first cost of construction and the annual operation and maintenance cost associated with each alternative; (4) estimate the benefits associated with each alternative; and (5) assess the impacts of each alternative on the existing environment based on the environmental data that was available. The results of the study were presented to the Ohio Department of Natural Resources and the U.S. Fish and Wildlife Service at the 29 May 1979 workshop meeting.

4. In view of Executive Order 11990, which prohibits Federal participation in construction in wetland areas when a practical alternative to such construction exists, Buffalo District made a preliminary interpretation as to whether or not the four alternative harbor layouts were "practical." In making this interpretation, Buffalo District considered, among other things, the stated views of ODNR and the U.S. Fish and Wildlife Service, the costs and benefits associated with each alternative, the impact of each alternative on the existing and future park facilities, the impact of each alternative on the environment, and the safety and well-being of the general public. It is noted, however, that due to the lack of current biological information for the area, a suitable mitigation plan could not be formulated for the alternatives studied and therefore its cost has not been included in the benefit-cost ratios that were developed. The preliminary interpretation of the Buffalo District is as follows:

a. Alternative #1 (Cowles Creek Alternative) - Even though the benefit-cost ratio for this alternative is greater than 1 (see Attachment 3), Alternative #1 was not considered a practical alternative for the following reasons:

(1) This alternative would destroy approximately one-half of the parking lot, cause relocation of the pedestrian foot bridge crossing Cowles Creek, and would reduce direct access to the bathhouse serving Beach A. It is also believed that ODNR would not support this alternative due to this disruption of existing park facilities.

(2) The entrance channel for this alternative would be between Beach A and Beach B and thus, boating activity would be placed in close proximity to swimming activities. This would create an unsafe condition. Although buoys would outline the limit of the swimming and boating areas, the probability of a potentially fatal accident is greater with this alternative than with the other alternatives investigated.

AD-A102 194 CORPS OF ENGINEERS BUFFALO NY BUFFALO DISTRICT F/G 13/2
GENEVA-ON-THE-LAKE OHIO. SMALL BOAT HARBOR. STAGE 2 DOCUMENT FO--ETC(U)
APR 80 R AGUGLIA, J ZORICH, S GOLYSKI, J POPE

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5 OF 5

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102 194

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(3) Due to the narrowness and orientation of the offshore trough which was utilized as the entrance channel for this alternative, the entrance conditions for boaters entering the harbor during storms are not as safe as the other alternatives studied. Storms originating from the northwest would cause waves to strike the entering boat broadside. Boaters would also be required to turn immediately after entering the entrance channel which will present difficulties to sailboaters. Relocating the entrance channel would require extensive rock excavation and an increase in breakwater length which would greatly increase the cost of this alternative.

b. Alternative #2 (offshore-onshore alternative) - Alternative #2 is considered a practical alternative for the following reasons:

(1) The benefit-cost ratio is greater than 1 (see Attachment 3).

(2) The alternative would not disrupt the existing and future park facilities.

(3) The alternative would directly impact only a limited area in the northeast corner of the wetland area which could be compensated for with suitable mitigation. It is noted, however, that this alternative would indirectly impact on the mouth of the drainage outlet for the wetland area. Due to the lack of biological information in the area, it is not known at this time whether or not this indirect impact is significant. When the information required to make this determination is available (October 1979), Buffalo District will reexamine its position on this alternative.

c. Alternative #3 (wetland parking lot alternative) - Alternative #3 is considered a practical alternative for the following reasons:

(1) The benefit-cost ratio is greater than 1.0 (see Attachment 3).

(2) Although this alternative would destroy a portion of the parking lot and would reduce access to the bathhouse, its impact would not be as severe as Alternative No. 1. It would not, however, interfere with the access between Beach A and Beach B.

(3) The impact of this alternative on the wetland area is basically the same as Alternative No. 2.

d. Alternative #4 (wetland alternative) - Since practical alternatives exist for construction of a small-boat harbor outside the wetland area, it is the opinion of the Buffalo District that construction of Alternative #4 would be in violation of Executive Order 11990. Therefore, it is Buffalo District's position that this alternative be eliminated from further consideration.

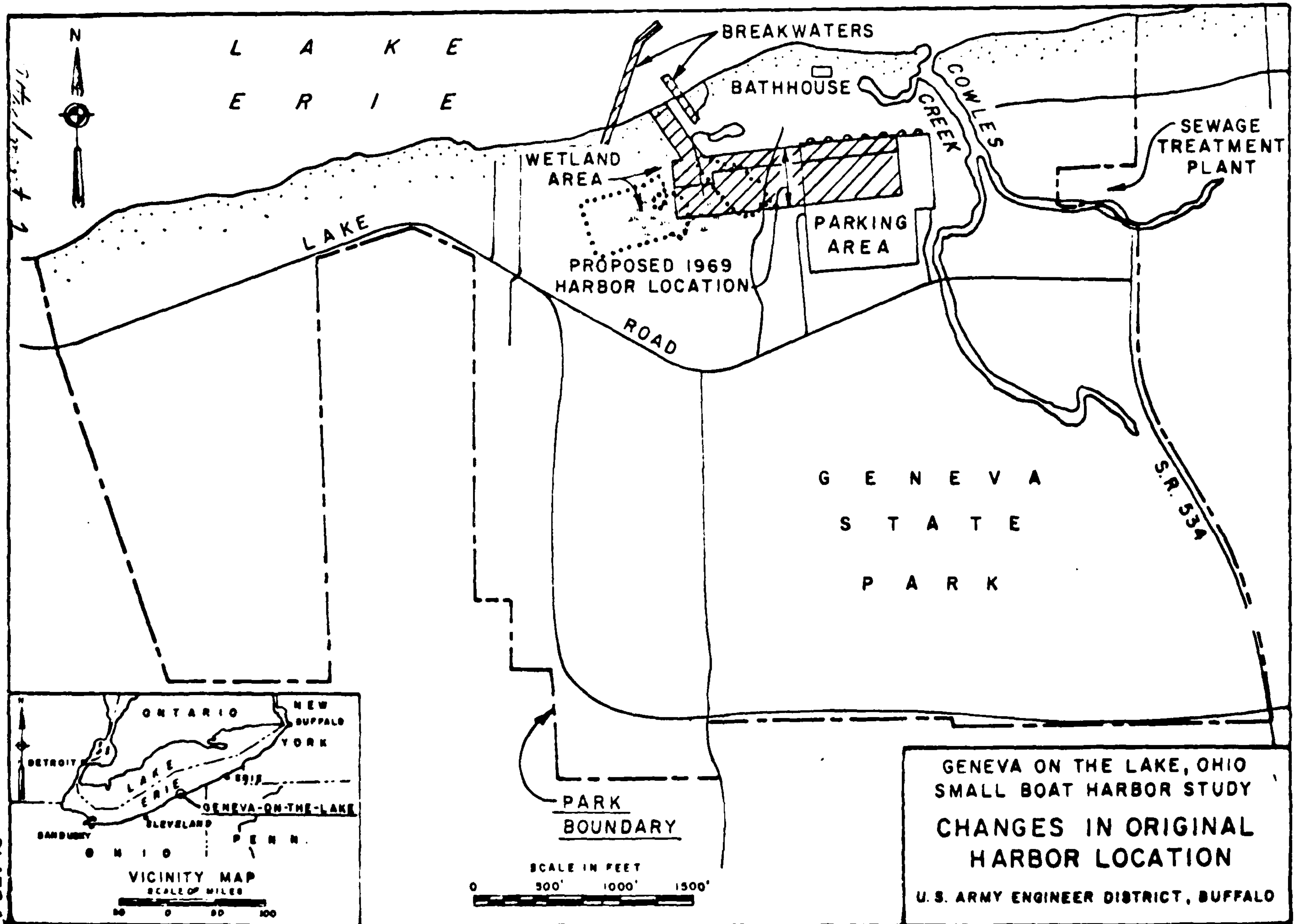
LAKE ERIE
N
BREAKWATERS
BATHHOUSE
COWLES CREEK
SEWAGE TREATMENT PLANT
WETLAND AREA
PROPOSED 1969 HARBOR LOCATION
PARKING AREA
LAKE ROAD
GENEVA STATE PARK
S.R. 534
PARK BOUNDARY
SCALE IN FEET
0 500' 1000' 1500'
ONTARIO
NEW YORK
BUFFALO
DETROIT
LAKE ERIE
ERIE
GENEVA-ON-THE-LAKE
CLEVELAND
SANDUSKY
OHIO
PENN.
VICINITY MAP
SCALE OF MILES
50 0 50 100
GENEVA ON THE LAKE, OHIO
SMALL BOAT HARBOR STUDY
CHANGES IN ORIGINAL HARBOR LOCATION
U.S. ARMY ENGINEER DISTRICT, BUFFALO

PLATE 1

## EXECUTIVE ORDER

### No. 11990

### May 24, 1977, 42 F.R. 26961

### PROTECTION OF WETLANDS

By virtue of the authority vested in me by the Constitution and statutes of the United States of America, and as President of the United States of America, in furtherance of the National Environmental Policy Act of 1969, as amended (42 U.S.C. 4321 et seq.), in order to avoid to the extent possible the long and short term adverse impacts associated with the destruction or modification of wetlands and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative, it is hereby ordered as follows:

**Section 1.** (a) Each agency shall provide leadership and shall take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities for (1) acquiring, managing, and disposing of Federal lands and facilities; and (2) providing Federally undertaken, financed, or assisted construction and improvements; and (3) conducting Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities.

(b) This Order does not apply to the issuance by Federal agencies of permits, licenses, or allocations to private parties for activities involving wetlands on non-Federal property.

**Sec. 2.** (a) In furtherance of Section 101(b)(3) of the National Environmental Policy Act of 1969 (42 U.S.C. 4331(b)(3)) to improve and coordinate Federal plans, functions, programs and resources to the end that the Nation may attain the widest range of beneficial uses of the environment without degradation and risk to health or safety, each agency, to the extent permitted by law, shall avoid undertaking or providing assistance for new construction located in wetlands unless the head of the agency finds (1) that there is no practicable alternative to such construction, and (2) that the proposed action includes all practicable measures to minimize harm to wetlands which may result from such use. In making this finding the head of the agency may take into account economic, environmental and other pertinent factors.

(b) Each agency shall also provide opportunity for early public review of any plans or proposals for new construction in wetlands, in accordance with Section 2(b) of Executive Order No. 11514,[31] as amended, including the development of procedures to accomplish this objective for Federal actions whose impact is not significant enough to require the preparation of an environmental impact statement under Section 102(2)(C) of the National Environmental Policy Act of 1969, as amended.

31. 42 U.S.C.A § 4321 note.



attachment 2

Sec. 3. Any requests for new authorizations or appropriations transmitted to the Office of Management and Budget shall indicate, if an action to be proposed will be located in wetlands, whether the proposed action is in accord with this Order.

Sec. 4. When Federally-owned wetlands or portions of wetlands are proposed for lease, easement, right-of-way or disposal to non-Federal public or private parties, the Federal agency shall (a) reference in the conveyance those uses that are restricted under identified Federal, State or local wetlands regulations; and (b) attach other appropriate restrictions to the uses of properties by the grantee or purchaser and any successor, except where prohibited by law; or (c) withhold such properties from disposal.

Sec. 5. In carrying out the activities described in Section 1 of this Order, each agency shall consider factors relevant to a proposal's effect on the survival and quality of the wetlands. Among these factors are:

(a) public health, safety, and welfare, including water supply, quality, recharge and discharge; pollution; flood and storm hazards; and sediment and erosion;

(b) maintenance of natural systems, including conservation and long term productivity of existing flora and fauna, species and habitat diversity and stability, hydrologic utility, fish, wildlife, timber, and food and fiber resources; and

(c) other uses of wetlands in the public interest, including recreational, scientific, and cultural uses.

Sec. 6. As allowed by law, agencies shall issue or amend their existing procedures in order to comply with this Order. To the extent possible, existing processes, such as those of the Council on Environmental Quality and the Water Resources Council, shall be utilized to fulfill the requirements of this Order.

Sec. 7. As used in this Order:

(a) The term "agency" shall have the same meaning as the term "Executive agency" in Section 105 of Title 5 of the United States Code and shall include the military departments; the directives contained in this Order, however, are meant to apply only to those agencies which perform the activities described in Section 1 which are located in or affecting wetlands.

(b) The term "new construction" shall include draining, dredging, channelizing, filling, diking, impounding, and related activities and any structures or facilities begun or authorized after the effective date of this Order.

(c) The term "wetlands" means those areas that are inundated by surface or ground water with a frequency sufficient to support and under normal circumstances does or would support a prevalence of vegetative or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction. Wetlands generally include swamps, marshes, bogs, and similar areas such as sloughs, potholes, wet meadows, river overflows, mud flats, and natural ponds.

Sec. 8. This Order does not apply to projects presently under construction, or to projects for which all of the funds have been appropriated through Fiscal Year 1977, or to projects and programs for which a draft or final environmental impact statement will be filed prior to October 1, 1977. The provisions of Section 2 of this Order shall be implemented by each agency not later than October 1, 1977.

Sec. 9. Nothing in this Order shall apply to assistance provided for emergency work, essential to save lives and protect property and public health and safety, performed pursuant to Sections 305 and 306 of the Disaster Relief Act of 1974 (88 Stat. 148, 42 U.S.C. 5145 and 5146).

Sec. 10. To the extent the provisions of Sections 2 and 5 of this Order are applicable to projects covered by Section 104(h) of the Housing and Community Development Act of 1974, as amended (88 Stat. 640, 42 U.S.C. 5304(h)), the responsibilities under those provisions may be assumed by the appropriate applicant, if the applicant has also assumed, with respect to such projects, all of the responsibilities for environmental review, decisionmaking, and action pursuant to the National Environmental Policy Act of 1969, as amended.

JIMMY CARTER

THE WHITE HOUSE,
*May 24, 1977.*

Attachment 3

## Summary of Project Costs and Benefits 1/
### Alternative No. 1

| Item | Federal | Non-Federal 2/ | Total 2/ |
|---|---|---|---|
| | $ | $ | $ |
| First Cost | 1,999,000 | 2,096,000 | 4,095,000 |
| Interest During Construction | 137,400 | 144,100 | 281,500 |
| Total Investment Cost | 2,136,400 | 2,240,100 | 4,376,500 |
| Lands and Damages | 0 | 557,000 | 557,000 |
| Total Project Costs | 2,136,400 | 2,797,100 | 4,933,500 |
| Annual Charges | | | |
| Interest | 146,900 | 192,300 | 339,200 |
| Amortization | 5,500 | 7,200 | 12,700 |
| Maintenance | 39,400 | 3,300 | 42,700 |
| Total | 191,800 | 202,800 | 394,600 |
| Annual Benefits 3/ | | | 459,500 |
| Benefit-Cost Ratio | | | 1.16 |

1/ Based on May 1979 price levels, 6-7/8 percent interest rate, and a 50-year economic life.

2/ Does not include self-liquidating cost for mooring area, launching ramps, and public service facilities currently estimated at $4,150,000 (May 1979 prive levels).

3/ Does not include benefits for recreational breakwater fishing.

## Summary of Project Costs and Benefits 1/
### Alternative No. 2

| Item | Federal | Non-Federal 2/ | Total 2/ |
|---|---|---|---|
| | $ | $ | $ |
| First Cost | 2,098,000 | 2,050,000 | 4,148,000 |
| Interest During Construction | 144,200 | 140,900 | 285,100 |
| Total Investment Cost | 2,242,200 | 2,190,900 | 4,433,100 |
| Lands and Damages | 0 | 50,000 | 50,000 |
| Total Project Costs | 2,242,200 2 | 2,240,900 | 4,483,100 |
| Annual Charges | | | |
| Interest | 154,100 | 154,100 | 308,200 |
| Amortization | 5,800 | 5,800 | 11,600 |
| Maintenance | 36,200 | 8,200 | 44,400 |
| Total | 196,100 | 168,100 | 364,200 |
| Annual Benefits 3/ | | | 459,500 |
| Benefit-Cost Ratio | | | 1.26 |

1/ Based on May 1979 price levels, 6-7/8 percent interest rate, and a 50-year economic life.

2/ Does not include self-liquidating cost for mooring area, launching ramps, and public service facilities currently estimated at $3,580,000 (May 1979 prive levels).

3/ Does not include benefits for recreational breakwater fishing.

## Summary of Project Costs and Benefits 1/
### Alternative No. 3

| Item | Federal | Non-Federal 2/ | Total 2/ |
|---|---|---|---|
| | $ | $ | $ |
| First Cost | 1,599,000 | 1,575,000 | 3,174,000 |
| Interest During Construction | 109,900 | 108,300 | 218,200 |
| Total Investment Cost | 1,708,900 | 1,683,300 | 3,392,200 |
| Lands and Damages | 0 | 404,000 | 404,000 |
| Total Project Costs | 1,708,900 | 2,087,300 | 3,796,200 |
| Annual Charges | | | |
| Interest | 117,500 | 143,500 | 261,000 |
| Amortization | 4,400 | 5,400 | 9,800 |
| Maintenance | 29,200 | 4,500 | 33,700 |
| Total | 151,100 | 153,400 | 304,500 |
| Annual Benefits 3/ | | | 459,500 |
| Benefit-Cost Ratio | | | 1.51 |

1/ Based on May 1979 price levels, 6-7/8 percent interest rate, and a 50-year economic life.

2/ Does not include self-liquidating cost for mooring area, launching ramps, and public service facilities currently estimated at $4,130,000 (May 1979 prive levels).

3/ Does not include benefits for recreational breakwater fishing.

## Summary of Project Costs and Benefits 1/
### Alternative No. 4

| Item | Federal | Non-Federal 2/ | Total 2/ |
|---|---|---|---|
| | $ | $ | $ |
| First Cost | 1,424,000 | 1,400,000 | 2,824,000 |
| Interest During Construction | 97,900 | 96,300 | 194,200 |
| Total Investment Cost | 1,521,900 | 1,496,300 | 3,018,200 |
| Lands and Damages | 0 | 78,000 | 78,000 |
| Total Project Costs | 1,521,900 | 1,574,300 | 3,096,200 |
| Annual Charges | | | |
| Interest | 104,600 | 108,200 | 212,800 |
| Amortization | 3,900 | 4,000 | 7,900 |
| Maintenance | 28,000 | 3,900 | 31,900 |
| Total | 136,500 | 116,100 | 252,600 |
| Annual Benefits 3/ | | | 459,500 |
| Benefit-Cost Ratio | | | 1.82 |

1/ Based on May 1979 price levels, 6-7/8 percent interest rate, and a 50-year economic life.

2/ Does not include self-liquidating cost for mooring area, launching ramps, and public service facilities currently estimated at $3,780,000 (May 1979 prive levels).

3/ Does not include benefits for recreational breakwater fishing.

# APPENDIX F

# PUBLIC INVOLVEMENT

## GENEVA-ON-THE-LAKE SMALL-BOAT HARBOR

STAGE 2 REPORT
OF
REFORMULATION PHASE I GENERAL DESIGN MEMORANDUM



U.S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, NY 14207

SUMMARY MINUTES OF 15 DECEMBER 1977
MEETING CONCERNING GENEVA-ON-THE-LAKE
SMALL BOAT HARBOR

A meeting was held at the Ohio Department of Natural Resources office in Columbus, OH, on 15 December 1977 to discuss the Geneva-on-the-Lake Small Boat Harbor. The names of the persons attending are on the attached list. Chuck Gilbert opened the meeting stating that the purpose of the meeting was to discuss some of the potential problems regarding the project for input to the Plan of Study which will be completed in April 1978.

Mel Rebholz stated that the project has a high priority in their department and that funds are available for the project under the capitol improvement bill. Ralph Henry stated that one of the primary items to be addressed is the location of the harbor in the park. There could be some major environmental problems in the proposed area. Also, the existing parking lot may require relocating the harbor site and this would result in increased construction cost if rock excavation is required.

James Swartzmiller stated that they do not want to remove the parking lot because it would reduce access to the beach area. He felt that the harbor could be moved west and still maintain the original capacity.

Denton Clark stated that rock probings indicate a high rock surface elevation to the south and west of the original harbor site. He stated

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that a geophysical study should be conducted in the area. There are indications of another bedrock trough in the Cowles Creek area and this should be considered as an alternative site.

Chuck Gilbert stated that consideration should be given to an off-shore harbor or acquisition of additional land for another harbor site.

James Swartzmiller stated that they do not want to acquire any additional land and are not opposed to an off-shore harbor.

John Zorich asked if the harbor configuration could be changed to allow the harbor to remain in the same area without requiring rock excavation. He also asked if the structure of the rock would prevent excavation without blasting. Denton Clark replied that the rock problem was the reason for the original design of the harbor in the survey report and does not know how difficult it would be to excavate the rock.

James Swartzmiller stated that the rock structure seemed very hard when they were driving pilings for other work in the area.

Denton Clark stated he believes the original plan should be used if the environmental problems can be remedied along with use of some of the parking area.

James Swartzmiller stated he is opposed to removing the parking lot or a large part of the parking lot because it would hinder use of the beach facilities. He felt that better rock data should be obtained

and then determine the benefits and costs of the new site before ruling out the area west of the original location. He also stated that the Cowles Creek area and an off-shore harbor should be considered.

Chuck Gilbert stated that an off-shore harbor would have much greater costs than the inland harbor based on studies for Port Ontario small boat harbor.

Fred Ball asked if the capacity of harbor could be reduced from the original capacity of 400 boats. Chuck Gilbert replied that the capacity could be reduced, however, a favorable benefit/cost ratio would still be necessary and reducing the capacity reduces the benefits.

Denton Clark asked if there are any problems in the Cowles Creek area. Fred Ball replied that there is a large number of trees in this area and more excavation would be required because of the higher terrain.

Chuck Gilbert asked if there is still a pollution problem in Cowles Creek from the sewage treatment plant. James Swartzmiller replied that the plant has been partially cleaned up and should not be a problem.

Bob Owens asked if the wetlands would be destroyed by the project and has any environmental assessment been done. Roger Hubbell replied that no environmental assessment has been made.

Ellen Cummings stated that the ponds were created by borrow excavation for the parking areas, so the area was previously disturbed.

Bob Owens stated that how the wetlands were created would not effect Fish and Wildlife's decisions. Mitigation may be necessary.

Mel Rebholz stated that ODNR is not opposed to mitigation.

Chuck Gilbert asked what areas of the park should not be considered for the harbor site. Roger Hubbell replied that the area west of the marina will be used for camp grounds. The eastern area has very high banks and is a picnic area. There does not appear to be much available space other than Cowles Creek and the original proposed area.

Denton Clark stated that his observations of wave action in the area indicate a high bedrock elevation. He asked if Arcola Creek should be considered as an alternative site. It was a considered site in the survey studies. Mel Rebholz replied that a regional sewage treatment development will be taking place in the area and does not believe this area should now be considered.

Norv Hall asked that if the rock problem is resolved, would the environmental situation prevent construction of the harbor. Bob Owens replied that it would depend upon the impact on the marsh. They would oppose the project if the marsh is destroyed, but would consider mitigation.

John Zorich asked if the productivity of the marsh is considered. Could the marsh be reduced if the productivity of the remaining area is increased. Bob Owens replied that this could be an acceptable solution.

Ellen Cummings stated that a field trip had been scheduled for 7 December with F&WL to look at the site, but had been cancelled because of snow.

Bob Owens stated that F&WL would not be able to visit the site until spring. John Zorich asked if ODNR has any environmental data for the area. Mel Rebholz replied that he does not believe there is any available information.

Denton Clark asked if ODNR would be willing to give up some of the parking lot if the Cowles Creek area is considered. James Swartzmiller replied that he had no objection to looking at the Cowles Creek area for the harbor. Mel Rebholz stated he had no objection to the Cowles Creek area. They had not considered it before because of the high ground.

Chuck Gilbert asked if the spoil from the harbor excavation area could be utilized constructively elsewhere in the park. Mel Rebholz replied that they don't know of any use for the material right now.

Fred Ball stated he feels the Cowles Creek site would split the beach area.

John Zorich asked if ODNR's geological department has any information on the rock structure in the area. Mel Rebholz replied that their data would not show enough detail.

John Zorich asked how high the proposed breakwaters would have to be raised in order to construct an off-shore harbor. Denton Clark replied that he would estimate about five additional feet above the authorized breakwater elevation.

Chuck Gilbert stated that because of the high cost for an off-shore facility it is difficult to justify the project.

Ellen Cummings asked if ODNR has an estimate of the needed capacity for the harbor. Norv Hall replied that they have an estimate of 250 boats but this is a rough estimate.

Denton Clark asked if people in the area are not buying boats because of lack of facilities. Norv Hall replied that he is not aware of this situation.

Ellen Cummings asked if they have an estimate of user days for recreational fishing. Norv Hall replied that they have information on this and will forward it to the Buffalo District.

Chuck Gilbert stated that recreational boat fishing should be considered as a benefit for the project also.

James Swartzmiller asked why the benefits for a harbor of refuge are only $10,000. Chuck Gilbert stated that there is no information available on what damages could have been prevented if a harbor of refuge

exists. The amount of $10,000 was used by the Corps at time the project was authorized and has not been changed.

James Swartzmiller stated he believes harbor of refuge is a very important aspect of the harbor and that he will gather some information on this.

Chuck Gilbert stated we would need past damage or possible loss of life information in order to increase the harbor of refuge benefits. He then asked if ODNR believes commercial fishing should be considered at the harbor.

Tom Goettke stated he is not familiar with any commercial fishing in the area. Because Ohio is developing stream fishing rather than Lake Erie fishing, the coho fishing is mainly confined to the streams. He does not believe charter fishing on Lake Erie would be established in the area because the more desirable sport fish are not in that area.

Horace Collins presented the available data on rock elevations in the area which did not have the detail necessary for plan formulation evaluation of alternative harbor sites.

He thought the rock information could be obtained with either a hand or power auger. He stated that shale is the predominant rock formation in the area and could possibly be excavated without excessive costs.

John Zorich stated that the rock elevation data should be done early in the study and that the proposed plan be rescaled to determine the exact area needed for the harbor. Ellen Cummings asked if the benefit/cost ratio could be less than one for the project. Chuck Gilbert replied that a NED plan would have to be developed with a favorable benefit/cost ratio but the selected plan could have a B/C ratio less than one if environmental enhancement results outweigh the change in benefits.

John Zorich asked if ODNR has an indication of the local residents opinion toward the harbor. Norv Hall replied that the local people are very much in favor of the project.

Chuck Gilbert asked if ODNR would provide Buffalo District with the names of interested people for addition to the mailing list. Norv Hall stated they would provide the list.

John Zorich stated that a public meeting is tentatively scheduled for February or March of 1978.

Chuck Gilbert asked if ODNR could provide Buffalo District with information on the fleet mix expected at the harbor. Norv Hall stated this information will be provided.

Denton Clark asked if ODNR knew of a facility in the area where a public meeting could be held. James Swartzmiller stated that the Geneva High School could probably be used.

Ellen Cummings asked if there are any records of attendance at the park. Tom Goettke stated that there is some information available and will forward the data to Buffalo District.

John Zorich asked if the proposed six foot depth in the mooring area is suitable. Norv Hall replied that six feet should be sufficient and could possibly be reduced in the mooring area for some boats.

John Zorich asked if a sight-seeing craft might base at the harbor and be included in the benefits. Chuck Gilbert stated this could be included as a project benefit. Norv Hall stated he does not believe this type of activity would be established at this area.

Ralph Henry asked if ODNR has an idea of the maximum amount of funds available for construction of the harbor. Norv Hall replied that he believes the upper limit would be around 2.5 million.

John Zorich asked if an explanation of the Corps planning process would be beneficial to those present. The ODNR representatives indicated they are aware of the Corps process and did not want further explanation.

Chuck Gilbert asked if ODNR has an area where spoil could be used. Roger Hubbell stated that some material could be used in the camp ground area.

Chuck Gilbert briefly summarized the meeting stating that two locations appear likely, the area immediately west of the original proposed location and at Cowles Creek. There does not appear to be a need for commerc

fishing facilities. ODNR will provide Buffalo District information on: the expected size and composition of the fleet, addresses of local interests, support for harbor of refuge benefits, and information on the State's fishing program. Spoil material may be used in the camp ground area. The upper limit of funds for the project would be about 2.5 million. The coordinator for the project will be James Swartzmiller. There is no environmental data available for the area. Fish and Wildlife probably could not visit the site until April or May.

John Zorich asked if there is any information available on the use of the launching ramp east of the park. Norv Hall stated he would obtain the information.

John Zorich asked if F&WL has performed a literature search for the area. Bob Owens replied that he did not know of anything being done on this, but would check with others in his office. John Zorich stated that the model study will not be initiated until the summer of 1979 when plan formulation is complete.

Denton Clark stated that the present breakwater configuration would be harmful to the downdrift area. The west breakwater should run more parallel to the shore and the east breakwater should be longer. A sand by-pass system would probably be recommended. A minimum of littoral information would be obtained from the model.

Brian Troyer stated that one of the items of local cooperation is for local interests to provide an area for spoil disposal for both construction and maintenance. Probably an upland disposal site would be required.

Ellen Cummings asked if any water quality data is available. Norv Hall stated that some data may be available from the park.

John Zorich asked if there would be any problem in obtaining access to the park for surveys. James Swartzmiller stated there would be no access problems.

Chuck Gilbert closed the meeting indicating that site location would be the primary investigative effort.

RALPH HENRY
Project Manager

MEETING 15 DECEMBER 1977 COLUMBUS, OH
OHIO DEPARTMENT OF NATURAL RESOURCES
GENEVA SMALL BOAT HARBOR
GENEVA-ON-THE-LAKE, OH

| | |
|---|---|
| James Swartzmiller | ODNR |
| Fred B. Ball | ODNR |
| Tom Goettke | ODNR |
| Steven H. Cole | ODNR - Division of Wildlife |
| Ralph Henry | Corps of Engineers, Buffalo |
| John Zorich | Corps of Engineers, Buffalo |
| Robert A. Owens | U.S. Fish & Wildlife Serv., East Lansing |
| Brian M. Troyer | Corps of Engineers, Buffalo |
| Ellen M. Cummings | Corps of Engineers, Buffalo |
| Norv Hall | ODNR |
| Charles E. Gilbert | Corps of Engineers, Buffalo |
| Denton R. Clark, Jr. | Corps of Engineers, Buffalo |
| Mel Rebholz | ODNR |
| Rober Hubbell | ODNR |
| Horace R. Collins | ODNR |

Geneva-on-the-Lake Small-Boat Harbor Study
Summary Minutes of 18 January 1979
Coordination Meeting of Corps and ODNR Personnel
Fountain Square, Building D, Columbus, OH

1. A meeting was held on 18 January 1979, in Columbus, OH, to review the results of the studies conducted to date on the small-boat harbor study and to come to a decision on what alternative harbor layouts are acceptable to the State of Ohio. The names of those persons in attendance are shown on the attached list. Chuck Gilbert opened the meeting at approximately 1:00 p.m. by welcoming all meeting participants and stated that the purpose of this meeting is to come to a mutual agreement on which preliminary harbor alternatives, developed by the Buffalo District, are acceptable to the State of Ohio. After the designs of these selected alternatives are completed, we will then hold a workshop meeting with ODNR, the U. S. Fish and Wildlife Service, and the Corps to review the results. Chuck then stated that for this meeting the Corps would first review the results of the studies conducted to date and then open the meeting to a general discussion of the alternatives.

2. Dick Aguglia reviewed the results of the seismic survey conducted at Geneva State Park to establish the top-of-rock profile in the area. Dick stated that the investigation confirmed the results of the boring program completed for the survey report which indicated that a trough exists in the bedrock that would allow a harbor to be constructed with no rock excavation. This trough runs generally east to west between Cowles Creek and the large pond in the wetland area and passes through the northern half of the existing parking lot. The seismic survey also indicated that a till layer overlays the bedrock in the Cowles Creek area. Based on our experience at Fairport Harbor, this till layer will be almost as costly to excavate as rock. ODNR will be provided with a copy of the seismic report when it is completed by the Corps.

3. John Lakatosh then reviewed the program currently in progress to assess the value of the wetland area. The U. S. Fish and Wildlife Service will conduct a four seasons survey on the Cowles Creek-wetland area-Lake Erie complex for the Buffalo District. The objectives of this study will be as follows:

a. to identify species composition, density, and distribution of the flora and fauna in the area;

b. to identify and evaluate the habitats important for major toxonomic groups; and

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c. to provide data and information that will allow assessment of the impacts of any structural plans that may be considered.

Based on a recent covnversation with the Fish and Wildlife Service, the preliminary data for the wetland area indicates that:

(1) the wetland area does not have a high productivity value for fisheries;

(2) the wetland area has a high productivity value for waterfowl; and

(3) the grassy areas bordering the wetland area have a high value for movement of mammals.

In addition to the four-seasons survey, the Fish and Wildlife Service will also collect water quality data on the wetland area (water quality data is currently available for Cowles Creek.) John also stated that the data will not be available for the Stage 2 report that will be completed in May. The environmental assessment required for this report will, therefore, be based on data that is currently available. The data from the four-seasons survey will be available, however, for the Environmental Impact Statement.

4. Chuck Gilbert asked if the marsh area by the cabins at the west end of the park (Wheeler Creek) could be considered as a possible site for mitigation measures. Jim Swartzmiller replied that this would be acceptable to ODNR. In that case, this marsh area will be included in the data collection program being conducted by the U. S. Fish and Wildlife Service.

5. Ralph Vanzant indicated that it may be inappropriate for the U. S. Fish and Wildlife Service to both collect the required environmental data and to assess the effects of any proposed harbor on the fish and wildlife resources of the area. Chuck Gilbert suggested that since ODNR is concerned about this, it would be a good idea to have one of their staff biologists assist the U. S. Fish and Wildlife Service in their data collection program.

6. Ron Guido then reviewed the results of the preliminary demand analysis conducted by the Corps. This demand analysis did not include the effect the proposed U. S. Steel Plant at Conneaut would have if it was built. The fleet mix that was generated from the demand analysis was based on our experience at Fairport Harbor. It is skewed towards cruisers since Lake Erie is not a good sailing area. Chuck Gilbert asked if this fleet mix appears reasonable. Norv Hall replied that he would get back to Ron after he has an opportunity to review it in detail.

7. Ron Guido then reviewed the methods the Corps will use to evaluate the benefits that will result from the project. Benefits from permanent-based boats are derived from the small-boat formula which is based on the depreciated value of the boat (for outboards this is 50 percent of the current purchase price.) Based on this formula, a 400-boat marina would provide about $200,000 average annual benefits and would support a project with a first cost of approximately $3,000,000 assuming a 50-year project life and 6-1/2 to seven percent interest rate. The benefits that result from launching facilities are calculated by converting it to an equivalent number of permanent-based boats. Other benefits include harbor-of-refuge benefits and pier fishing benefits. Ron will also investigate the possibility of using area development benefits although this type of benefit has been rejected in the past by Buffalo's Division Office (North Central.)

8. Dick Aguglia then reviewed the general design considerations for the preliminary harbor layouts formulated by the Corps. Two types of harbors were investigated:

a. a fair-weather harbor with day berthing for approximately 100 boats; and

b. an all-weather 400-boat marina.

With each alternative, the Corps tried to develop plans which would comply with the restrictions of rock elevation, the wetland area, and existing park facilities. These preliminary alternatives were formulated to outline the total range of alternatives that the Corps feels exist. Dick also reviewed the results of the Port Ontario harbor-of-refuge project on Lake Ontario with which the Corps is involved to illustrate the difference in cost between an offshore facility and an inland facility. The offshore facility had an estimated cost of $7,400,000 and the inland facility (of the same capacity) had an estimated cost of $3,500,000. Thus, the offshore facility would be approxiamtely twice as expensive to construct as the inland facility. The difference in cost was due to the following factors:

a. the increased size of the breakwaters required for the offshore facility; and

b. the increased length of the breakwaters required for the offshore facility.

Applying this factor of two to the estimated $3,200,000 cost of the authorized project at Geneva (with a B/C ratio of 1.2), the offshore facility has an estimated cost of $6,400,000 with a resultant B/C ratio of 0.6. Thus, it appears that an offshore facility at Geneva would not be economically feasible.

9. Roger Hubbell asked if the cost of mitigation is included in the cost of the project. Chuck Gilbert replied that it is included in the cost of the project and is also included in the developed B/C ratio. Therefore, the cost-sharing arrangements for mitigation measures would be the same as for the other features of the project (50 percent Federal and 50 percent non-Federal for the project at Geneva ). Chuck also stated that if additional land is required, this cost would be entirely non-Federal because the local sponsor is required to supply all lands, easements, and rights-of-way.

10. Joan Pope then reviewed the results of the sounding program conducted to establish the offshore contours at Geneva State Park. There appears to be two areas where the eight-foot contour dips in towards shore:

a. opposite Cowles Creek; and

b. opposite the drainage outlet into the lake for the wetlands.

In order to avoid extensive offshore rock excavation (after about the four-foot contour, top of rock elevation is the same as the depth of water) the harbor entrance must utilize one of these two areas.

11. Joan Pope briefly reviewed the eight alternative harbor layouts formulated by the Corps and provided to ODNR prior to the meeting. Joan then stated that one alternative that was considered by the Corps, but subsequently rejected, was a rectangular-shaped harbor entirely within the wetland area. The reason why it was rejected was that we felt that storm-generated waves entering between the breakwaters would set up oscillations within the basin that could not be controlled.

12. A general discussion then took place. The main points discussed were as follows:

a. Jim Swartzmiller and Norv Hall stated that the State needs a harbor-of-refuge at Geneva State Park, therefore, Alternatives No. 5 and No. 6 (fair-weather harbors) should not be considered further. Also, due to their high cost, Alternatives No. 7 and No. 8 (offshore harbors) should not be considered further. Jim also stated that ODNR does not favor Alternative No. 1 (since it would isolate the bathhouse), but that the Corps should still consider it since this is the alternative the U. S. Fish and Wildlife Service favors. A bridge would be required to preserve access from the bathhouse to the bathing areas. Jim then stated that Alternatives No. 3 and No. 4 appear most feasible, but that they should go as far south in the wetland area as rock will allow before utilizing the existing parking lot.

b. Chuck Gilbert stated that the U. S. Fish and Wildlife Service normally requires the sponsoring agency to submit a mitigation plan for their review. Since it will not be known what items must be mitigated until the assessment of the area is completed, the State does not want to formulate a mitigation plan at this time. At the workshop meeting in March (see Item c), the State will take the position that they are agreeable to mitigation and will formlulate a plan after the area assessment is completed.

c. A workshop meeting will be held in March with ODNR, the U. S. Fish and Wildlife Service, and the Corps. At this time, the Corps will present the refined designs for Alternatives No. 1, No. 2, No. 3, and No. 4, cost estimates, and resultant benefit/cost ratios for review.

d. Dick Aguglia asked if the Corps should consider a harbor larger than 400 boats. Jim Swartzmiller replied that we should stay with a 400-boat harbor at this time. If a larger harbor is required to increase the B/C ratio, it can be discussed at the March workshop meeting.

13. Dick Aguglia then briefly summarized the decisions reached at this meeting as follows:

a. The Corps will refine Alternatives No. 1, No. 2, No. 3, and No. 4. While refining Alternatives No. 3 and No. 4, the Corps will go as far south in the wetland area as rock will allow before utilizing the existing parking lot.

b. Alternatives No. 5, No. 6, No. 7, and No. 8 should not be considered further.

c. Norv Hall will review the generated fleet mix and provide Ron Guido with his comments.

d. There will be a workshop meeting with ODNR, the U. S. Fish and Wildlife Service, and the Corps in March.

e. ODNR is agreeable to mitigation and will formulate a plan after the area assessment is complete.

f. The size of the marina will remain at 400 boats at this time.

14. Chuck Gilbert adjourned the meeting at 3:30 p.m.

1 Attachment
Attendees

RICHARD AGUGLIA
Project Manager

Geneva-on-the-Lake Small-Boat Harbor Study Coordination Meeting:
18 January 1979

Attendance

| Name | Organization |
| --- | --- |
| James Swartzmiller | Chief Engineer, ODNR |
| Charles Gilbert | Chief, Planning, Branch, COE |
| Ralph Vanzant | ODNR |
| Fred Ball | ODNR |
| Roger Hubbell | ODNR |
| Norv Hall | ODNR |
| Robert Lucas | ODNR |
| Richard Aguglia | Planning Branch, COE |
| John Lakatosh | Environmental Section, COE |
| Joan Pope | Coastal Section, COE |
| Ron Guido | Economic Section, COE |

GENEVA-ON-THE-LAKE SMALL-BOAT HARBOR STUDY
SUMMARY MINUTES OF 29 MAY 1979
COORDINATION MEETING OF CORPS, USF&WL, AND ODNR PERSONNEL
GENEVA STATE PARK, GENEVA-ON-THE-LAKE, OHIO

1. A meeting was held on 29 May 1979 at Geneva State Park to review the four alternative harbor plans developed by the Buffalo District and to come to a decision on the future course of the study. The names of those persons in attendance are shown on the attached list. Don Liddell opened the meeting at approximately 1:30 p.m. by welcoming all meeting participants and introducing the Corps personnel in attendance. Don then stated that the purpose of this meeting was to review the four alternative harbor layouts prepared by the Corps and to come to a decision on which harbor alternative was acceptable to both the U.S. Fish and Wildlife Service (USF&WL) and the Ohio Department of Natural Resources (ODNR). He explained that the alternatives that were developed take into consideration the existing and future park facilities and the existing wetland area. They run the spectrum from one alternative that preserves the wetland area to one alternative that preserves the existing and future park facilities. Don then stated that the alternatives should be considered as concepts that will have to be refined in later stages of the study if a decision can be reached on which harbor alternative is acceptable to both agencies. Don stressed the need for a mutually acceptable alternative since the Corps probably would not recommend construction of an alternative unless it was supported by both agencies.

2. Dick Aguglia stated that the rock profile in the area was also considered in developing these alternatives. The harbor alternatives were located to minimize rock excavation.

3. Dick Aguglia then briefly reviewed the four harbor alternatives. The main points discussed were as follows:

a. Alternative No. 1 (Cowles Creek Alternative) - Alternative No. 1 consists of a breakwater-protected entrance channel and an interior channel leading to a mooring area at the mouth of Cowles Creek for 100 boats and a mooring area in the parking lot area for 300 boats. The alternative also includes a sediment trap in Cowles Creek to prevent the sediment carried by Cowles Creek from entering the mooring area and the navigation channel. Besides disrupting a major portion of the parking lot, this alternative would also require the relocation of the existing foot bridge crossing Cowles Creek. The cost for removing this bridge would be a cost-shared item. However, the cost for replacing the bridge would be a non-Federal cost, although it is included in the benefit/cost ratio (b/c ratio).

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In addition, due to the narrowness and orientation of the offshore trough in the rock which was utilized as the entrance channel for this alternative, the entrance conditions for boaters entering the harbor during storms are not as safe as the other alternatives investigated. Storms originating from the northwest would cause waves to strike the entering boat broadside. Boaters would also be required to turn immediately after entering the entrance channel. This alternative would also place boating activity in close proximity to swimming activities, creating an unsafe condition. The cost of this alternative is approximately $5,000,000, including $557,000 for lands and damages (includes the value of the land utilized by the harbor, the cost of the parking lot which is removed, and the depreciated value of the bathhouse due to reduced access), with a b/c ratio of 1.16 (the b/c ratio does not include the benefits for breakwater fishing or a cost for mitigation of adverse environmental impacts). The self-liquidating costs (mooring area, launching ramps, and public service facilities) are roughly estimated at $4,200,000.

Conrad Fjetland questioned whether it was appropriate to depreciate the value of the bathhouse due to reduced access since the bathhouse is presently not being used to any great extent. Conrad also asked if this alternative would create a beach in front of the bathhouse, since the predominate littoral drift in the area is from west to east, and thus increase the value of the bathhouse. Dick Aguglia replied that if a sand bypass is not provided, erosion of the bluffs and swimming area on the downdrift side of the breakwaters would occur. However, the State could truck in sand and create a beach in front of the bathhouse and the breakwater would help hold it in place.

b. Alternative No. 2 (Onshore-Offshore Alternative) - Alternative No. 2 consists of a breakwater-protected entrance channel, a breakwater-protected offshore mooring area for 300 boats, and an interior channel leading to an inland mooring area for 100 boats. The breakwaters required for this plan are approximately three feet higher than for the other alternatives in order to provide adequate protection for boats moored out in the lake. This alternative may also require the construction of an additional parking lot to the west of the harbor to service the offshore mooring area. The cost of this alternative is approximately $4,500,000, including $50,000 for lands and damages, with a b/c ratio of 1.26 (the b/c ratio does not include the benefits for breakwater fishing or a cost for mitigation of adverse environmental impacts). The self-liquidating costs are roughly estimated at $3,600,000 (does not include the cost of a possible parking lot to the west).

Due to the lack of biological information in the area, a mitigation plan for this alternative could not be formulated at this time.

Possible suggestions include a tree buffer zone between the wetland and the mooring areas and increasing the size of the ponds in the wetland area and building small islands within these ponds. In addition, since the existing drainage outlet for the wetlands will be affected, Buffalo District proposes to install an outlet control structure. This structure can be set at one elevation, or several outlet elevations can be incorporated to be used during different times of the year. The costs of these possible mitigation features have not been included in the b/c ratio for this or any other alternative.

c. Alternative No. 3 (Wetland-Parking Lot Alternative) - Alternative No. 3 consists of a breakwater-protected entrance channel and an interior channel leading to a mooring area for 60 boats and a mooring area for 340 boats. The alternative utilizes about one-quarter of the wetland area and one-quarter of the parking lot. The cost of this alternative is approximately $3,800,000, including $404,000 for lands and damages, with a b/c ratio of 1.51 (the b/c ratio does not include the benefits for breakwater fishing or costs for mitigation). The self-liquidating costs are roughly estimated at $4,100,000.

d. Alternative No. 4 (Wetland Alternative) - Alternative No. 4 consists of a breakwater-protected entrance channel and an interior channel leading to a mooring area for 160 boats and a mooring area for 240 boats. The alternative utilizes about half of the wetland area while leaving the existing parking lot intact. The cost of this alternative is approximately $3,100,000, including $78,000 for lands and damages, with a b/c ratio of 1.82 (the b/c ratio does not include the benefits for breakwater fishing or costs for mitigation). The self-liquidating costs are roughly estimated at $3,800,000.

4. Dick Aguglia then reviewed Executive Order 11990 which prohibits Federal participation in projects which destroy wetlands if a practical alternative to such construction exists. In view of this Executive Order, Buffalo District made a preliminary determination as to whether or not each alternative was "practical." Based on this interpretation, Buffalo District concluded that Alternatives No. 2 and No. 3 were practical alternatives. Buffalo District did not, however, feel that Alternative No. 1 was practical due to its major interruption to existing park facilities. Since it was considered that practical alternatives to construction in the wetland area exists, it was also concluded that Alternative No. 4 would not conform to Executive Order 11990 and therefore should be dropped from further consideration. Of the two practical alternatives, Buffalo District prefers Alternative No. 2 even though it costs more because it minimizes the impact on the wetlands and the existing park facilities.

5. Dick Aguglia then stated that for the remainder of the meeting we would like to have a position from the USF&WL Service and ODNR in order to come to an agreement on a preferred alternative. If we cannot come to an agreement, then we should decide on what future course the study should take.

6. Conrad Fjetland asked why the alternatives were designed to hold 400 boats and why the entrance channel was eight feet deep and the interior channel and mooring areas were six feet deep. Dick Aguglia replied that, based on experience at other harbors, 400 boats were the minimum needed to justify a project of this type. Also, ODNR has stated that this is the size harbor they prefer, although we may adjust it somewhat during later stages of the study. In regard to the depths for the channels and mooring areas, they were selected based on the conditions at similar harbors designed by the Corps. Workshops will be held with local boaters in the Summer of 1979 to ascertain their desires and needs and adjustments in depths, if required, will be made at that time.

7. Conrad further stated that he had two questions concerning the practicality of Alternative No. 1: (1) Would ODNR have to add more parking facilities if Alternative No. 1 was constructed? and (2) Since Alternative No. 1 would create a beach in front of the bathhouse, where would ODNR like to have a beach?

8. Dick Aguglia replied that, since a 400-boat marina would require approximately 1,000 parking spaces, ODNR would have to construct additional parking facilities if Alternative No. 1 was constructed (the existing capacity of the parking lot is 1,200 cars).

9. Jim Swartzmiller asked if a beach could be constructed in front of the bathhouse with Alternatives No. 2, 3, and 4 by building a groin field? Joan Pope replied that probably a breakwater plan would work better, but that this would have to be studied further. Dick Aguglia replied that a Section 103 Reconnaissance Report on Shoreline Erosion at Geneva State Park was completed in November 1977 and recommended that a Detailed Project Report (DPR) be completed. In the reconnaissance report, a groin field to create a beach in front of the bathhouse and increase the size of the beach east of Cowles Creek was found to be feasible. This would have to be studied further, however, in the DPR. Jim Swartzmiller stated that, under any circumstances, the State wants a beach in front of the bathhouse.

10. Conrad Fjetland stated that the direct impacts to the wetland area with Alternative No. 2 are minimal and its indirect impact, due to its proximity to the wetlands, could be mitigated. The indirect impact of interfering with the randomly fluctuating drainage outlet for the wetland area, however, could be significant. Conrad stated

they should have sufficient data available in October to make a determination as to whether or not this indirect impact is significant.

11. Don Liddell stated that, even though Buffalo District prefers Alternative No. 2, if ODNR and the USF&WL Service prefer either Alternative No. 1 or No. 3, we would have no objection. Buffalo selected No. 2 because it seemed the best compromise of the three alternatives. Buffalo does not feel that Alternative No. 4 would conform to Executive Order 11990.

12. Norv Hall stated that Alternatives No. 2 and No. 3 were over $1,000,000 more than Alternative No. 4, and Alternative No. 1 was over $2,000,000 more. This is a concern to ODNR and should be considered in determining the practicality of the alternatives.

13. Don Liddell stated that, in order to recommend Alternative No. 4, we would have to include a significant cost for mitigation. This additional cost would probably increase the cost for Alternative No. 4 to the same level as the other alternatives. Conrad Fjetland stated that the loss of the wetland with Alternative No. 4 could probably not be mitigated.

14. Don Liddell stated that he would like to have a position from ODNR. Jim Swartzmiller replied that they would have to study the alternatives in greater detail before they state their position. Before making their decision, they need the following information: (1) a breakdown of the self-liquidating costs; (2) plates of the four alternatives; (3) a plate showing top of rock and offshore contours; and (4) Buffalo District's interpretation of the practicality of the four alternatives in regard to Executive Order 11990. Dick Aguglia replied that this information would be provided to ODNR and the USF&WL Service. (Note: Information was supplied by letters dated 5 June 1979 and 13 June 1979).

15. Jim Swartzmiller also stated that ODNR does not want two beaches separated by a small-boat harbor. They want one continuous beach between the bathhouse and Beach B to the east of Cowles Creek.

16. Dick Aguglia summarized the results of the discussion to this point as follows:

a. The USF&WL Service, pending a determination of the significance of the randomly fluctuating drainage outlet for the wetland area, could accept Alternatives No. 2 or No. 3 with suitable mitigation. They would, however, prefer Alternative No. 1.

b. ODNR does not want Alternative No. 1 because it isolates the bathhouse and splits their beaches. They prefer Alternative No. 4 because it is the least costly alternative.

17. Conrad Fjetland replied that the USF&WL Service would prefer Alternative No. 2 over Alternative No. 3. In addition, he felt that the mitigation costs for this alternative would be minimal. Conrad also stated that his report, dated 4 May 1979, did not rule out Alternatives No. 1, 2, or 3. Alternative No. 4 would not, however, be acceptable since the damage to the wetlands could not be mitigated.

18. Jim Swartzmiller replied that, before making a decision, they must examine not only the construction costs of each alternative but also the operating costs for each alternative. Don Liddell requested that ODNR make this decision by 1 July 1979 in order that it may be incorporated into the Stage 2 report currently scheduled for the end of July.

19. Conrad Fjetland stated that, since the State desires a beach in front of the bathhouse, the cost of constructing this beach should be included in the analysis of the four alternatives. He also asked what the demand is for swimming facilities at Geneva State Park. John Zorich replied that Buffalo District is currently conducting a recreational beach demand analysis for the entire U.S. shore of Lake Erie for the International Joint Commission. The results of this study should be available in January 1980. ODNR will supply Buffalo with existing data on recreational use at Geneva State Park. In addition, ODNR will supply Buffalo with coliform data for Cowles Creek as per Paul Lang's request.

20. Don Liddell stated that in order to complete the Stage 2 report, as scheduled, we need comments from ODNR and the USF&WL Service by 1 July 1979. If it is required, we could also have another meeting in July to review their comments. Don then adjourned the meeting at 4:30 p.m.

RICHARD AGUGLIA
Project Manager

GENEVA-ON-THE-LAKE SMALL-BOAT HARBOR STUDY COORDINATION MEETING
29 MAY 1979

ATTENDANCE

| Name | Organization |
| --- | --- |
| James Swartzmiller | Chief Engineer, ODNR |
| Conrad Fjetland | Supervisor, USF&WL Service |
| Don Liddell | Chief, Engineering Division, COE |
| Alan Brackney | USF&WL Service |
| Clyde Simmeren | ODNR |
| Norv Hall | ODNR |
| Roger Hubbell | ODNR |
| Mike Colvin | ODNR |
| Doug Burgett | ODNR |
| John Zorich | Planning Branch, COE |
| Richard Aguglia | Planning Branch, COE |
| Paul Lang | Environmental Section, COE |
| Joan Pope | Coastal Section, COE |

# APPENDIX G

# REPORTS OF OTHERS

## GENEVA-ON-THE-LAKE SMALL-BOAT HARBOR

STAGE 2 REPORT
OF
REFORMULATION PHASE I GENERAL DESIGN MEMORANDUM

Exhibit G - 1 U. S. Fish and Wildlife Service Report

U. S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, NY 14207

United States Department of the Interior

FISH AND WILDLIFE SERVICE

IN REPLY REFER TO:

Division of Ecological Services
Columbus Field Office
3990 East Broad Street
Columbus, Ohio 43215

May 4, 1979

Colonel Daniel D. Ludwig
District Engineer
U. S. Army Engineer District
Buffalo
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Ludwig:

This letter provides an intermediate report by the U. S. Fish and Wildlife Service regarding our four season survey for the Geneva-on-the-Lake Small-Boat Harbor Study. Fishery data at this point is very incomplete as many species of fish that may ascend the three study streams will not do so until higher water temperatures are reached. Trap netting, electroshocking, and seining will continue through summer and early fall.

Waterfowl surveys conducted during the fall of 1978 indicated heavy use of the marsh area as a nocturnal roost, particularly for wood ducks. As many as 157 wood ducks were observed roosting in the southern edge of the marsh in one night. The general area also provides resting and feeding opportunities for many species of waterfowl. As many as 50 coots and 16 geese were observed in or around the marsh area. Spring surveys indicate extensive use of the area for resting, roosting, and feeding by ducks, geese, herons, shorebirds, gulls, hawks, owls, kingfishers, woodpeckers, and various passerine birds. Wood ducks, mallards, and blue-winged teal may also be nesting in the area. The marsh and borrow pits also appear to serve as a sheltered resting area for diving ducks when storms force them off the open lake. On 6 April 1979 during a severe storm, 270 Bonaparte's gulls and 81 waterfowl were observed resting in the wetland complex. While we also observed use of Cowles Creek and Wheeler Creek by various species of waterfowl, the number of birds observed was generally much lower than in the marsh/swamp complex.

The following preliminary comments on the four suggested alternative harbor layouts are presented in light of the survey data gathered to date.

Alternative No. 1 — (Buffalo Corps District Plans - February 1979)

The alternative harbor layout with the entrance between the beach bathhouse and Cowles Creek would appear to be the least destructive of wetland areas. Accelerated erosion east of the breakwaters could be a serious problem but would occur with any of the four alternative layouts unless protective measures are

EXHIBIT G-1

taken. This alternative would interrupt direct access between the bathhouse and the beach at the base of the bluff picnic area. However, the west to east littoral drift would probably build a beach to the west of the breakwaters, providing a much more convenient location for swimmers than that presently being used. Unwanted human intrusion into the marsh/swamp complex would need to be controlled.

Alternatives No. 2 and No. 3 -- (Buffalo Corps District Plans - February 1979)

While Alternatives No. 2 and No. 3 directly impact only a limited area in the northeast corner of the wetland complex, their indirect impacts could be very serious. During most of the year, the outflow of the marsh/swamp complex is blocked by a sand and gravel bar thrown up by on-shore winds. This blockage results in a water level in the marsh that may be as much as one to two feet above the lake level. The increase in depth and surface area greatly increases the value of the complex to both fish and wildlife. Additionally, the proximity of the harbor in either of these two alternatives may preclude use of the marsh by those waterfowl that are least tolerant of disturbance. This problem would be much more serious with either Alternative No. 2 or 3 than with Alternative No. 1.

Alternative No. 4 -- (Buffalo Corps District Plans - February 1979)

Alternative No. 4 would, of course, directly destroy a major portion of the marsh. Indirect impacts would be more serious than those associated with any of the other alternatives. Water levels in the swamp could be severely lowered. Additionally, the proximity of the harbor to the large borrow pit and to the swamp would almost certainly reduce their use by various species of wildlife.

In the view of the U. S. Fish and Wildlife Service, the selection of any alternative that would directly destroy or indirectly modify the marsh/swamp complex west of the beach parking lot would not be in compliance with Executive Order 11990. Direct impacts would include the excavation or filling of the wetland area. Indirect modification would include construction of breakwaters flanking the mouth of the marsh that would interfere with the natural fluctuation of the water level in the marsh/swamp complex. Indirect adverse impacts might also include construction of the harbor in such close proximity to the wetland that use of the wetland by wildlife is seriously reduced. At this time, we believe that Alternative No. 1 is a practicable alternative and its selection would result in the least direct and indirect damage to the wetland areas.

Sincerely yours,

Conrad A. Fjetland
Supervisor

cc: Regional Administrator, U.S. EPA, Federal Activities Br., Chicago, IL
ODNR, Outdoor Recreation Serv., Attn: Mike Colvin, Columbus, OH
Regional Director, FWS, Twin Cities, MN (LWR)
Area Manager, FWS, East Lansing, MI (ES)

# APPENDIX H

## STUDY MANAGEMENT

GENEVA-ON-THE-LAKE SMALL-BOAT HARBOR

STAGE 2 REPORT
OF
REFORMULATION PHASE I GENERAL DESIGN MEMORANDUM

Exhibit H - 1 CPM
Exhibit H - 2 Proposed Schedule of Major Activities

U. S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, NY 14207

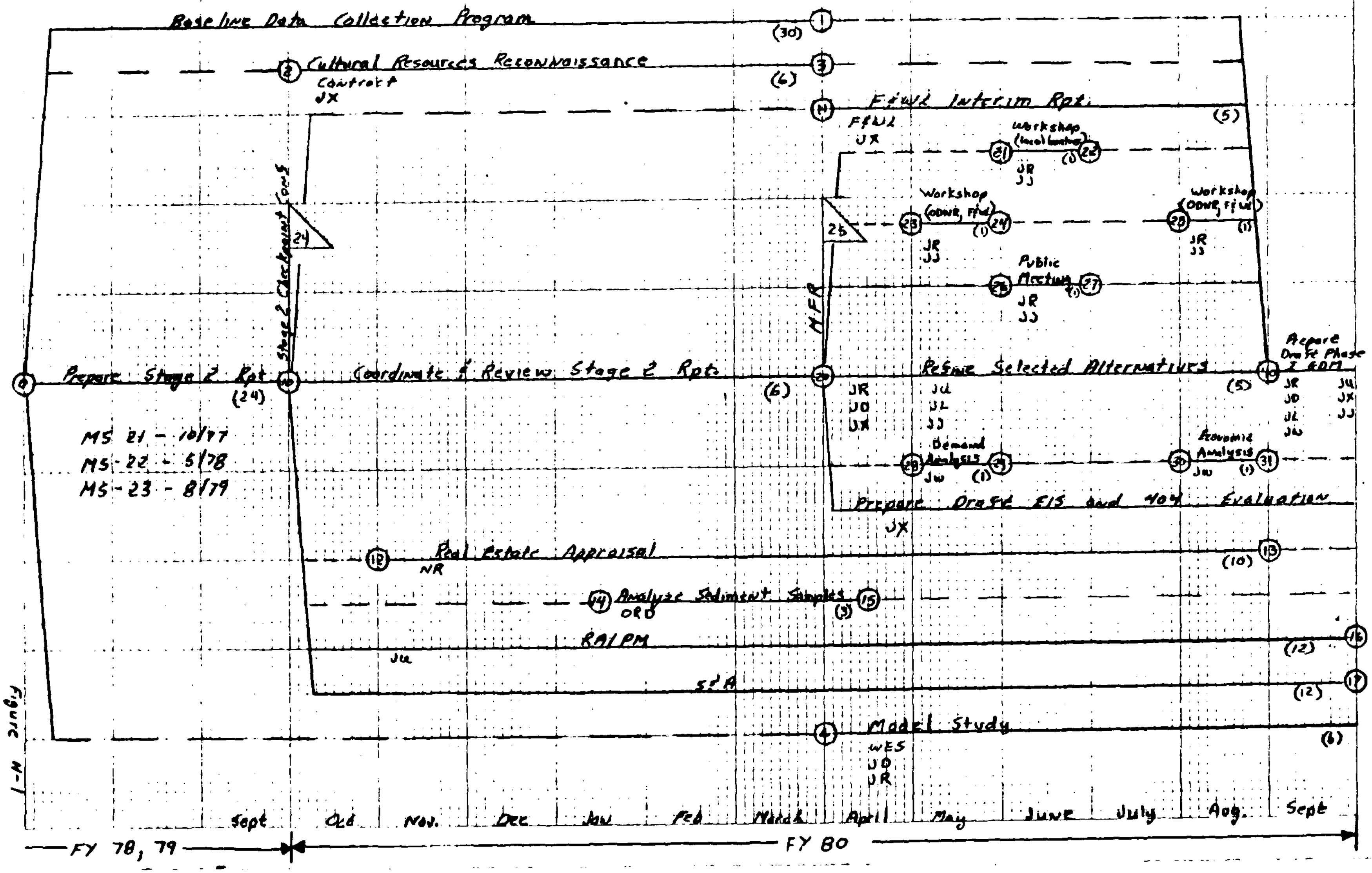

Baseline Data Collection Program
(30)
Cultural Resources Reconnaissance
Contract
JX
(6)
FFWL Interim Rpt.
FFWL
JX
(5)
Stage 2 Checkpoint Conf.
24
25
MFR
Workshop (local leaders)
JR
JJ
(1)
Workshop (ODWR, FFWL)
JR
JJ
(1)
Public Meeting
JR
JJ
(1)
Workshop (ODWR, FFWL)
JR
JJ
(1)
Prepare Stage 2 Rpt
(24)
Coordinate & Review Stage 2 Rpts
(6)
Refine Selected Alternatives
JR
JD
JX
JL
JL
JJ
(5)
Prepare Draft Phase I GDM
JR
JD
JL
JW
JU
JX
JJ
Demand Analysis
JW
(1)
Economic Analysis
JW
(1)
Prepare Draft EIS and 404 Evaluation
JX
MS 21 - 10/77
MS-22 - 5/78
MS-23 - 8/79
Real Estate Appraisal
NR
(10)
Analyze Sediment Samples
ORD
(3)
RAIPM
JU
(12)
S&A
(12)
Model Study
WES
JD
JR
(6)
Sept
Oct
Nov.
Dec
Jan
Feb
March
April
May
June
July
Aug.
Sept
FY 78, 79
FY 80

Figure H-1

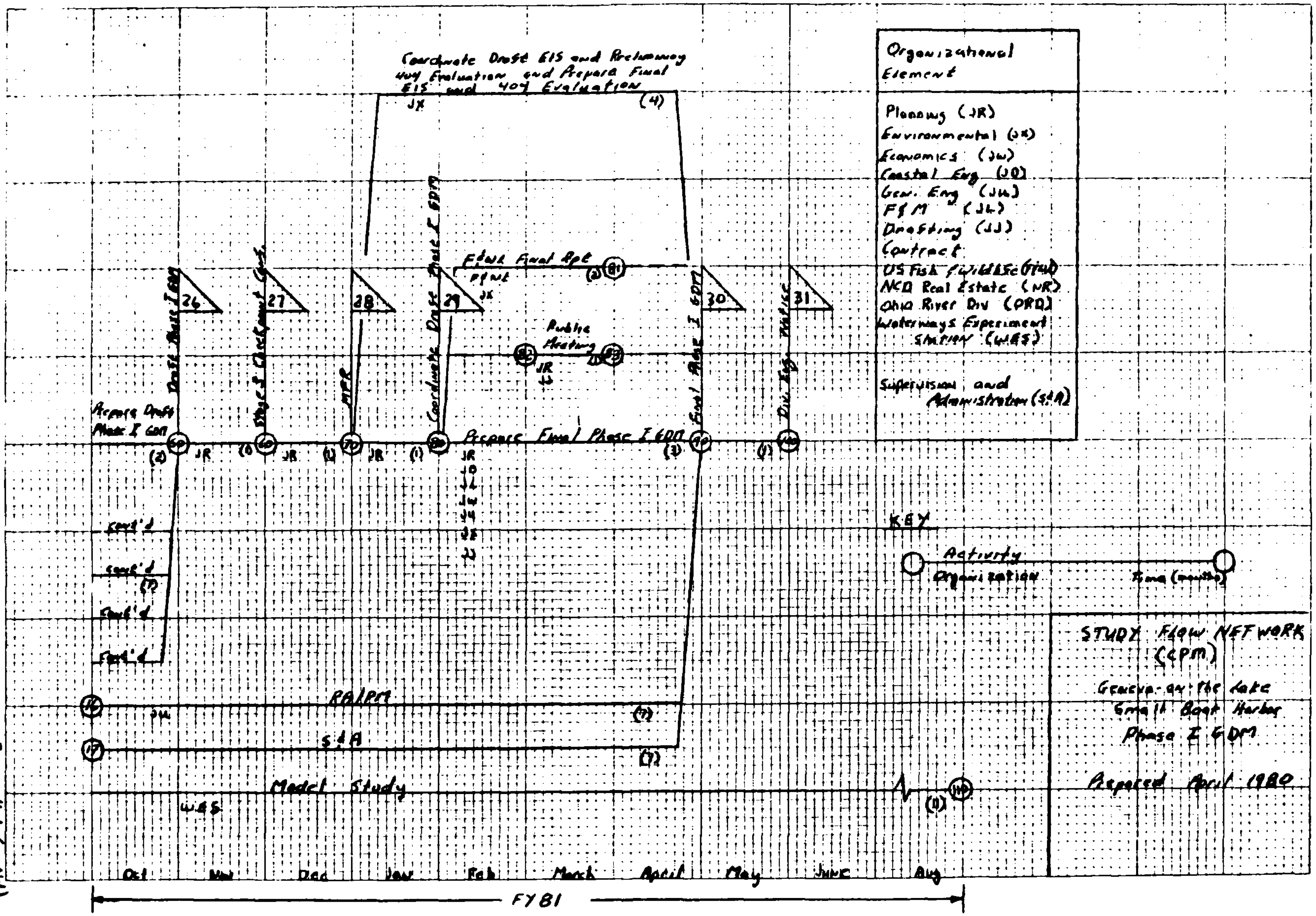
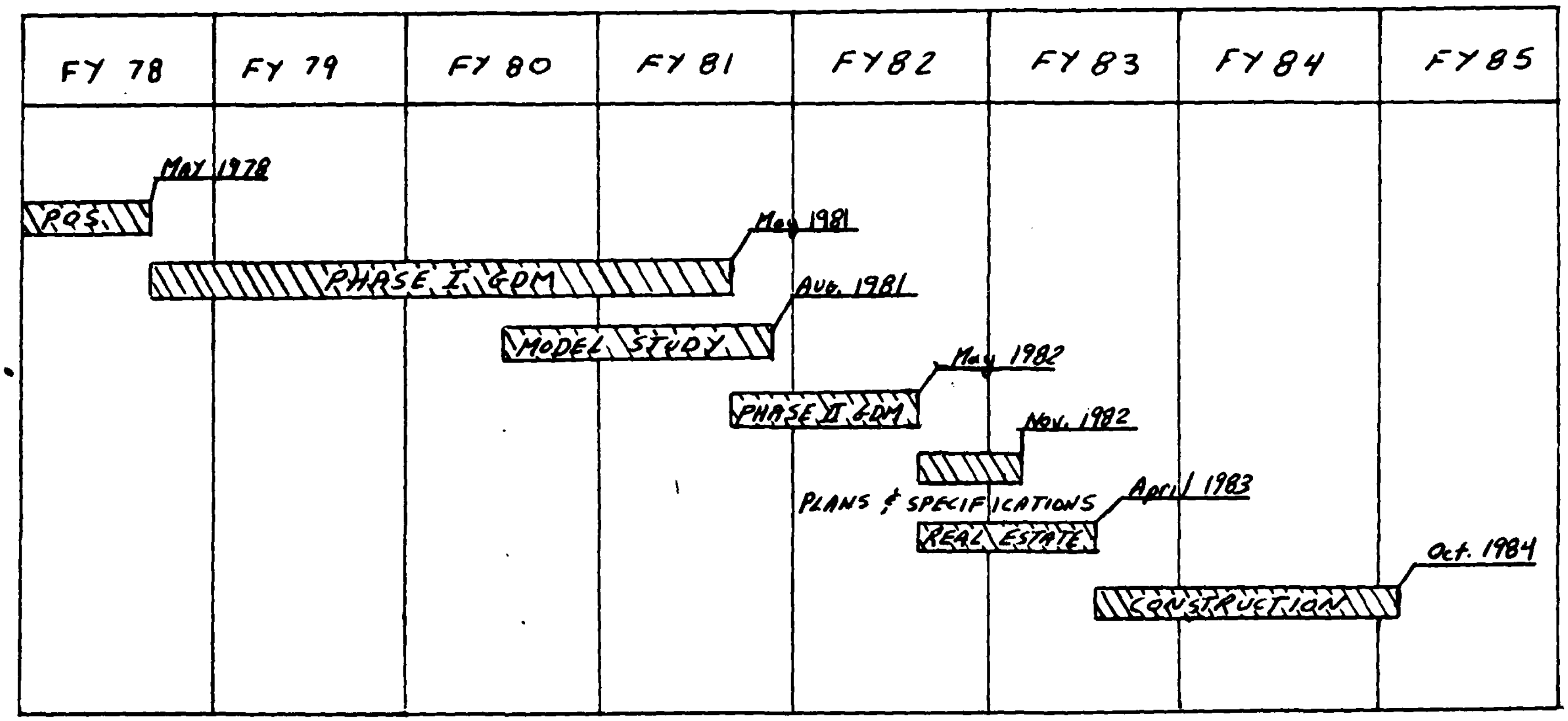



Figure H-1 (cont'd)

47 0700

## PROPOSED SCHEDULE OF MAJOR ACTIVITIES

## GENEVA-ON-THE-LAKE SMALL BOAT HARBOR




PREPARED APRIL 1980

Figure H-2

APPENDIX I

PLATES

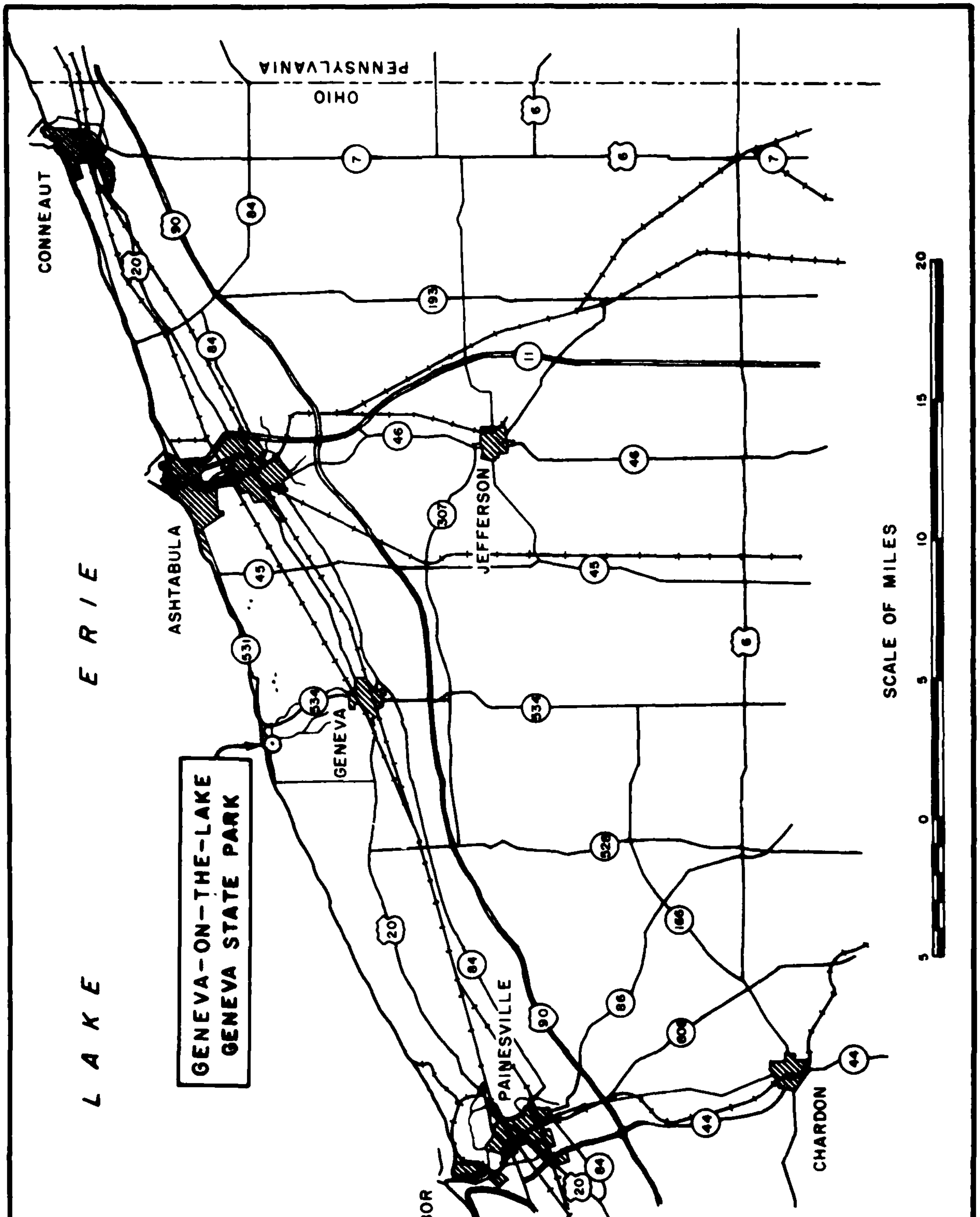
GENEVA-ON-THE-LAKE SMALL-BOAT HARBOR

STAGE 2 REPORT
OF
REFORMULATION PHASE I GENERAL DESIGN MEMORANDUM

U.S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, NY 14207

APPENDIX I

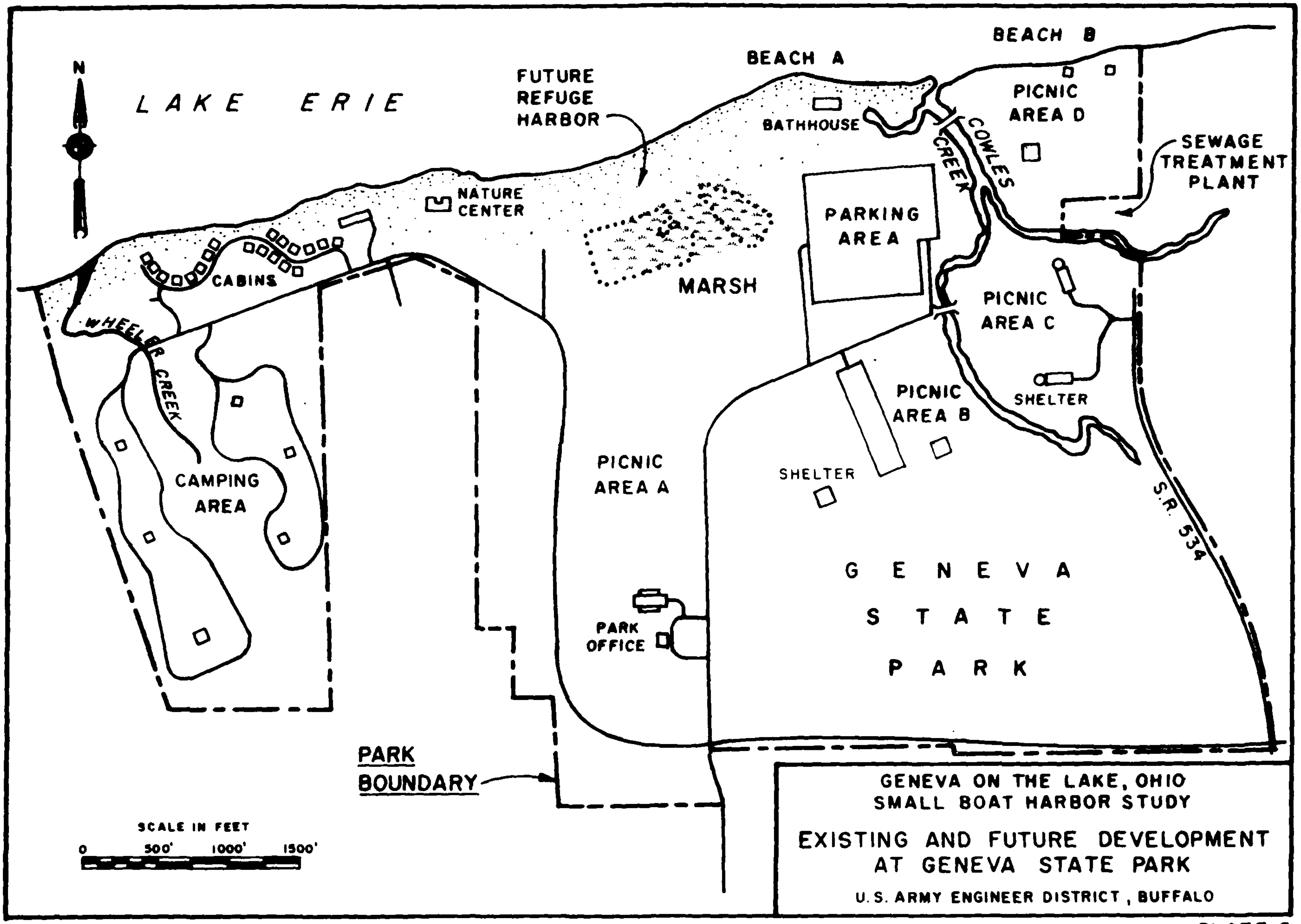
PLATES




GENEVA STATE PARK
GENEVA, OHIO

**REGIONAL LOCATION MAP**

U.S. ARMY ENGINEER DISTRICT, BUFFALO




GENEVA ON THE LAKE, OHIO
SMALL BOAT HARBOR STUDY

EXISTING AND FUTURE DEVELOPMENT AT GENEVA STATE PARK

U.S. ARMY ENGINEER DISTRICT, BUFFALO

PLATE 2

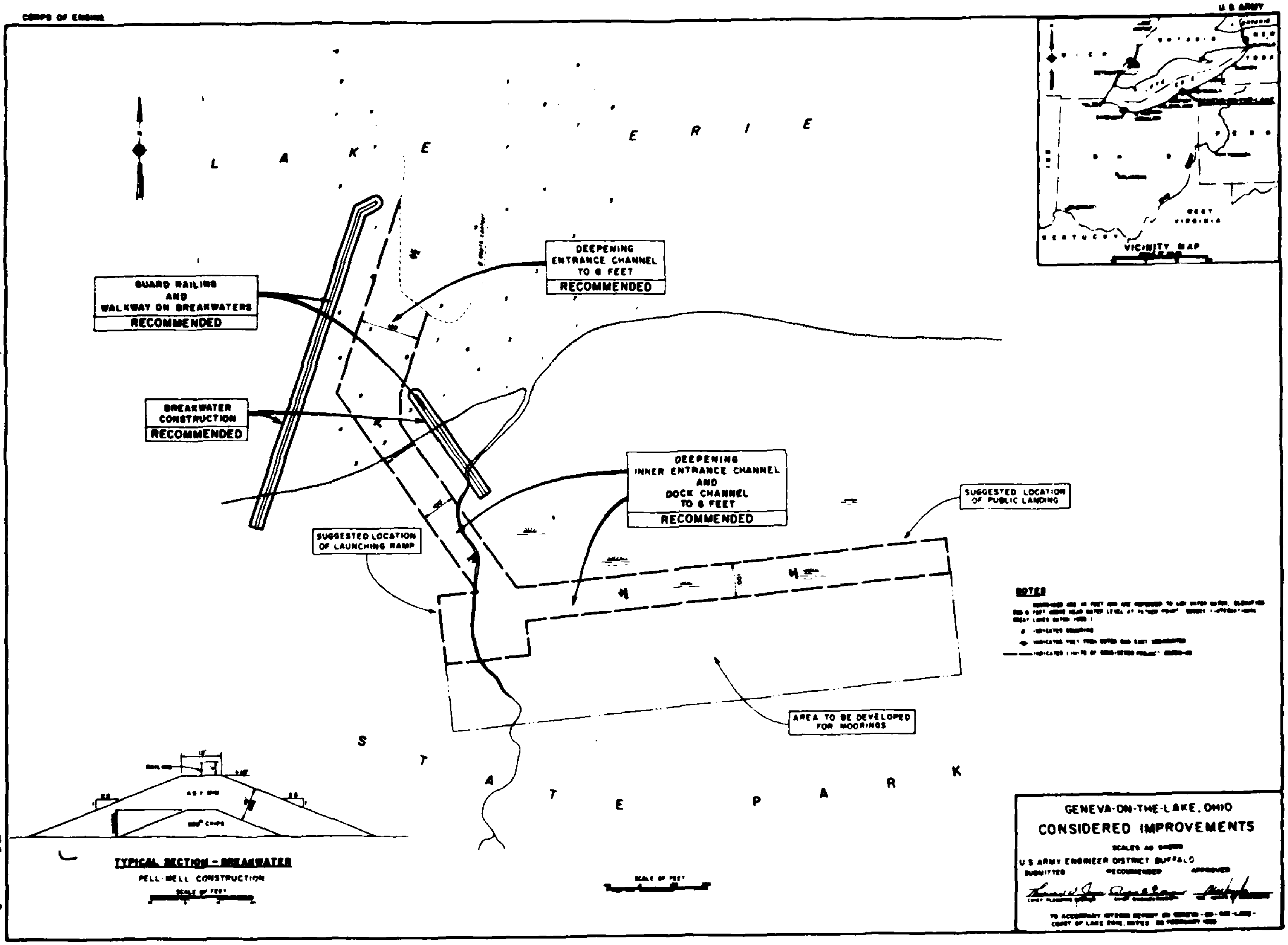
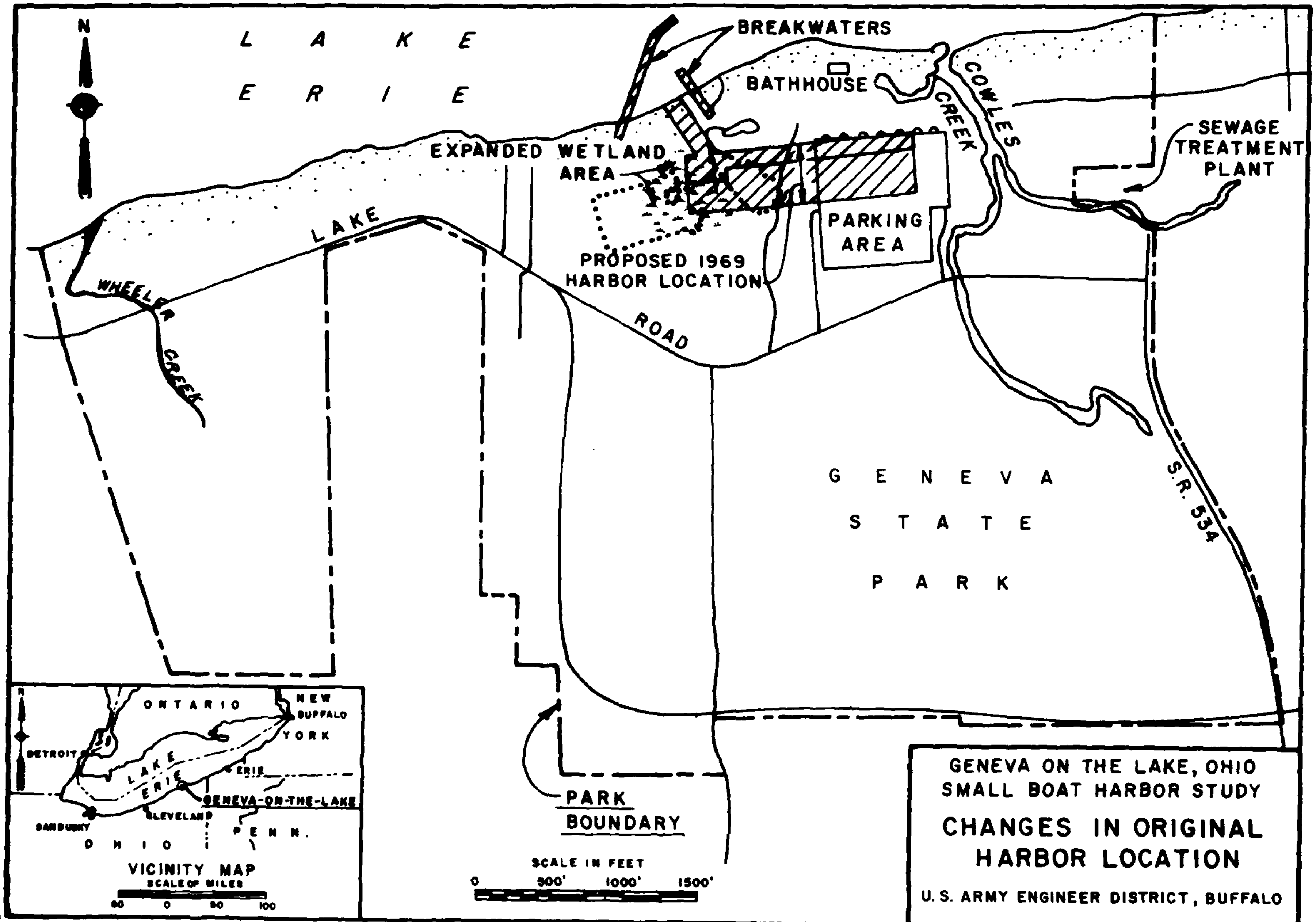

CORPS OF ENGINEERS
U.S. ARMY
LAKE ERIE
GUARD RAILING AND WALKWAY ON BREAKWATERS
RECOMMENDED
BREAKWATER CONSTRUCTION
RECOMMENDED
DEEPENING ENTRANCE CHANNEL TO 6 FEET
RECOMMENDED
DEEPENING INNER ENTRANCE CHANNEL AND DOCK CHANNEL TO 6 FEET
RECOMMENDED
SUGGESTED LOCATION OF LAUNCHING RAMP
SUGGESTED LOCATION OF PUBLIC LANDING
AREA TO BE DEVELOPED FOR MOORINGS
STATE PARK
VICINITY MAP
NOTES
TYPICAL SECTION - BREAKWATER
PELL-MELL CONSTRUCTION
SCALE OF FEET
GENEVA-ON-THE-LAKE, OHIO
CONSIDERED IMPROVEMENTS
SCALES AS SHOWN
U.S. ARMY ENGINEER DISTRICT BUFFALO
SUBMITTED
RECOMMENDED
APPROVED

Plate 3




GENEVA ON THE LAKE, OHIO
SMALL BOAT HARBOR STUDY

**CHANGES IN ORIGINAL HARBOR LOCATION**

U.S. ARMY ENGINEER DISTRICT, BUFFALO

PLATE 4

PLATE 4

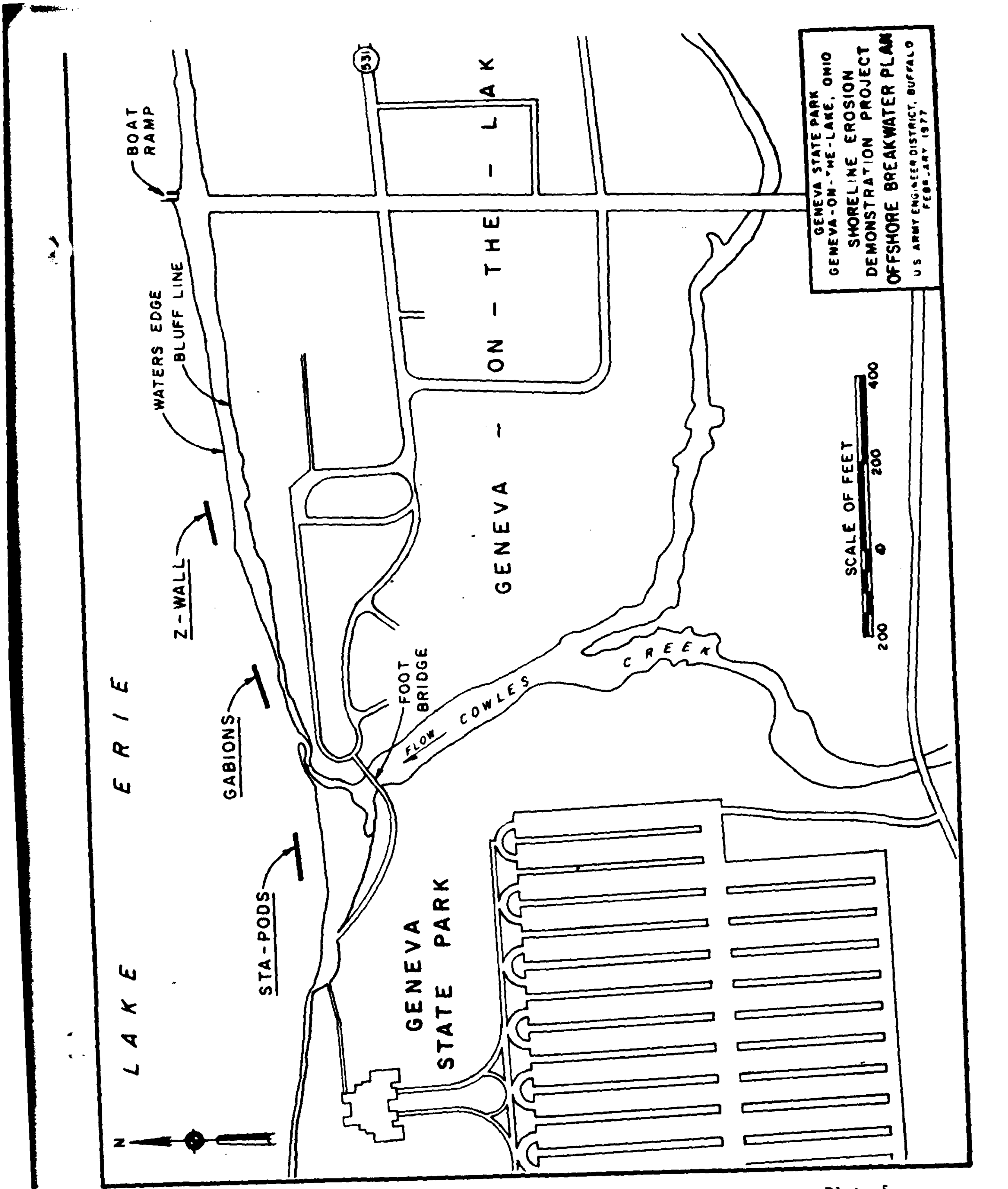

LAKE ERIE
STA-PODS
GABIONS
Z-WALL
WATERS EDGE
BLUFF LINE
BOAT RAMP
531
GENEVA - ON - THE - LAK
GENEVA STATE PARK
FOOT BRIDGE
FLOW
COWLES CREEK
SCALE OF FEET
200 0 200 400
N
GENEVA STATE PARK
GENEVA-ON-THE-LAKE, OHIO
SHORELINE EROSION
DEMONSTRATION PROJECT
OFFSHORE BREAKWATER PLAN
US ARMY ENGINEER DISTRICT, BUFFALO
FEBRUARY 1977

Plate 5

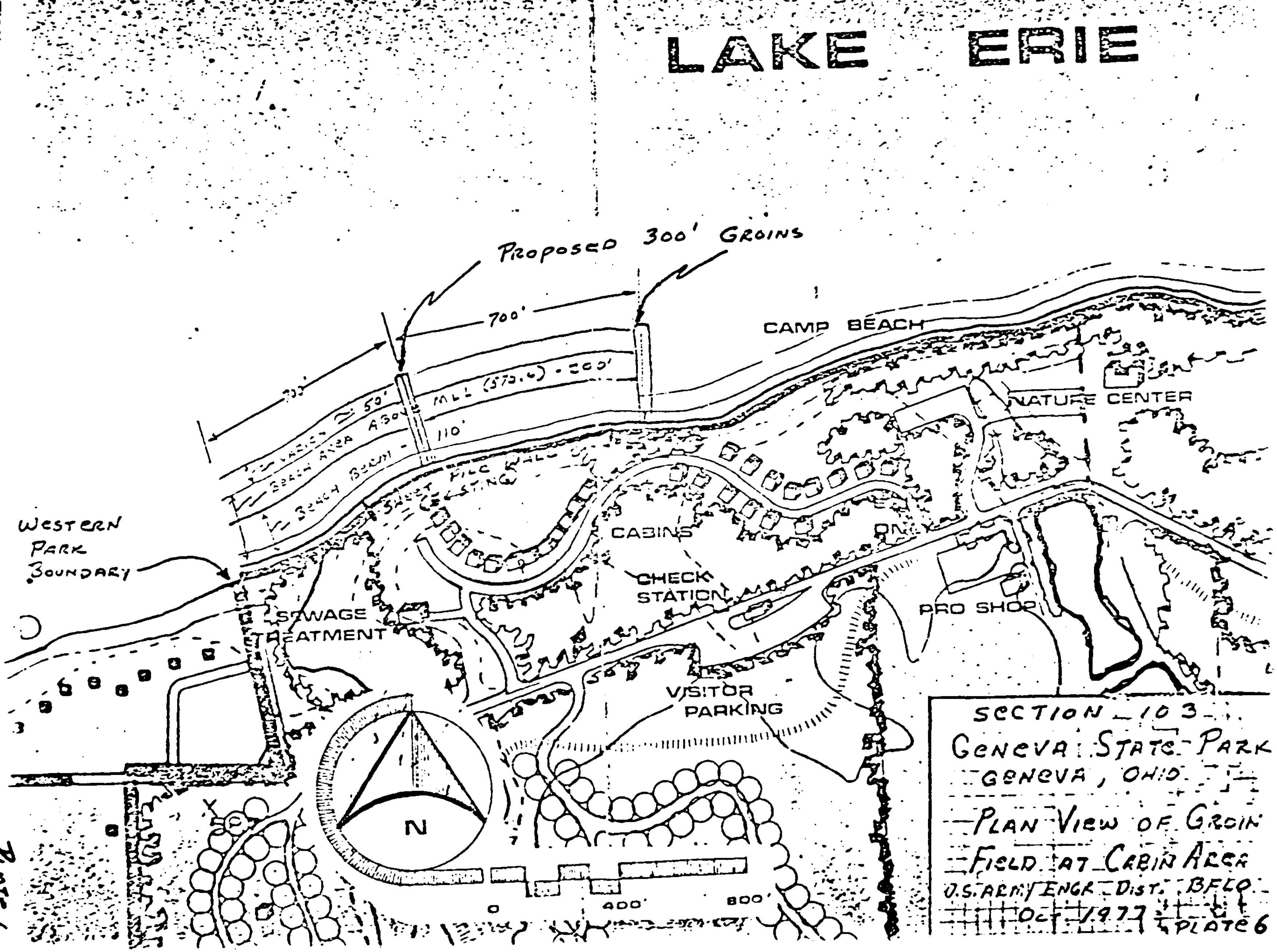

LAKE ERIE
PROPOSED 300' GROINS
700'
CAMP BEACH
NATURE CENTER
CABINS
CHECK STATION
SEWAGE TREATMENT
VISITOR PARKING
PRO SHOP
WESTERN PARK BOUNDARY
N
0
400'
800'
SECTION 103
GENEVA STATE PARK
GENEVA, OHIO
PLAN VIEW OF GROIN FIELD AT CABIN AREA
U.S. ARMY ENGR. DIST. BFLO.
OCT. 1977
PLATE 6

PLATE 6

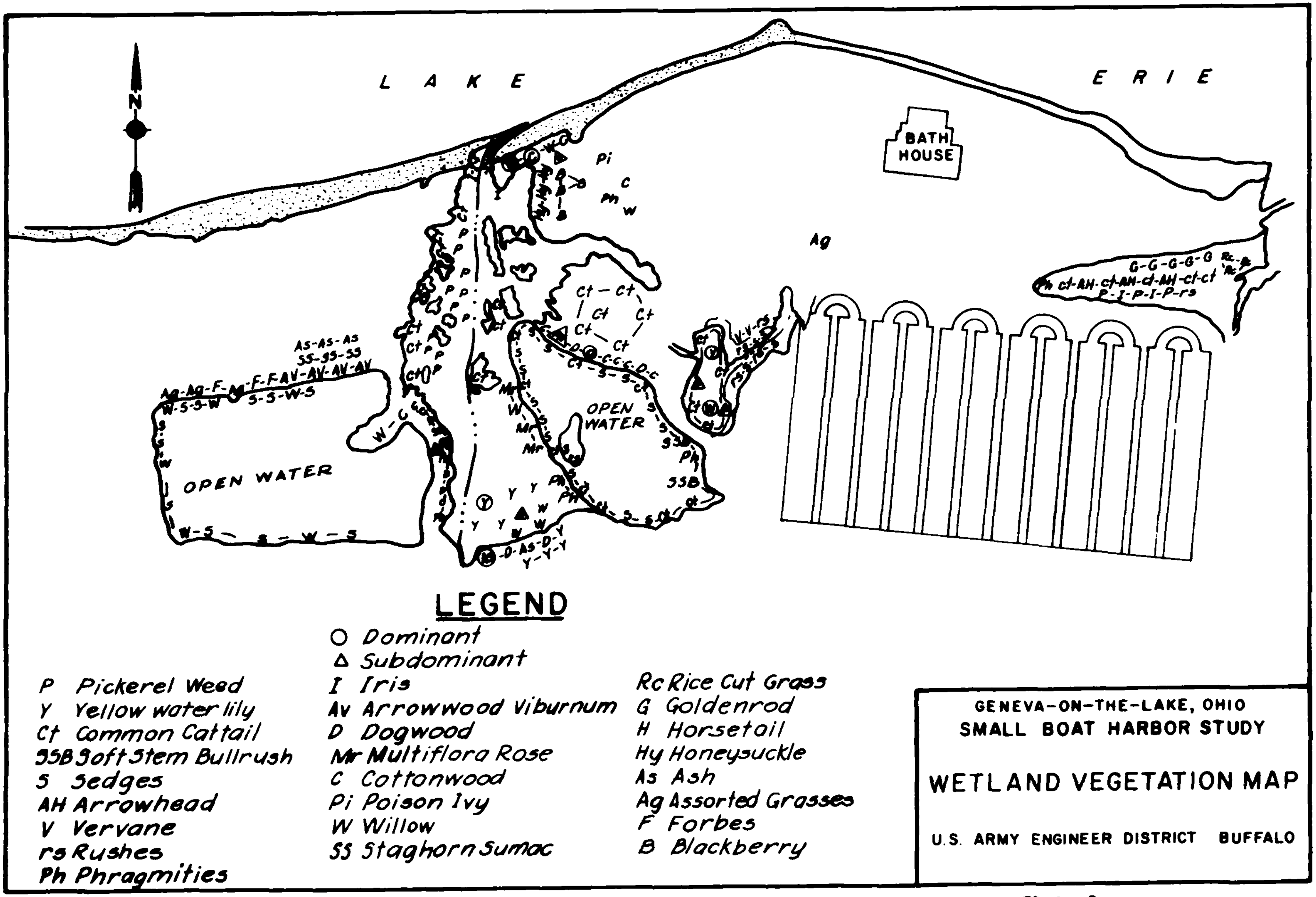
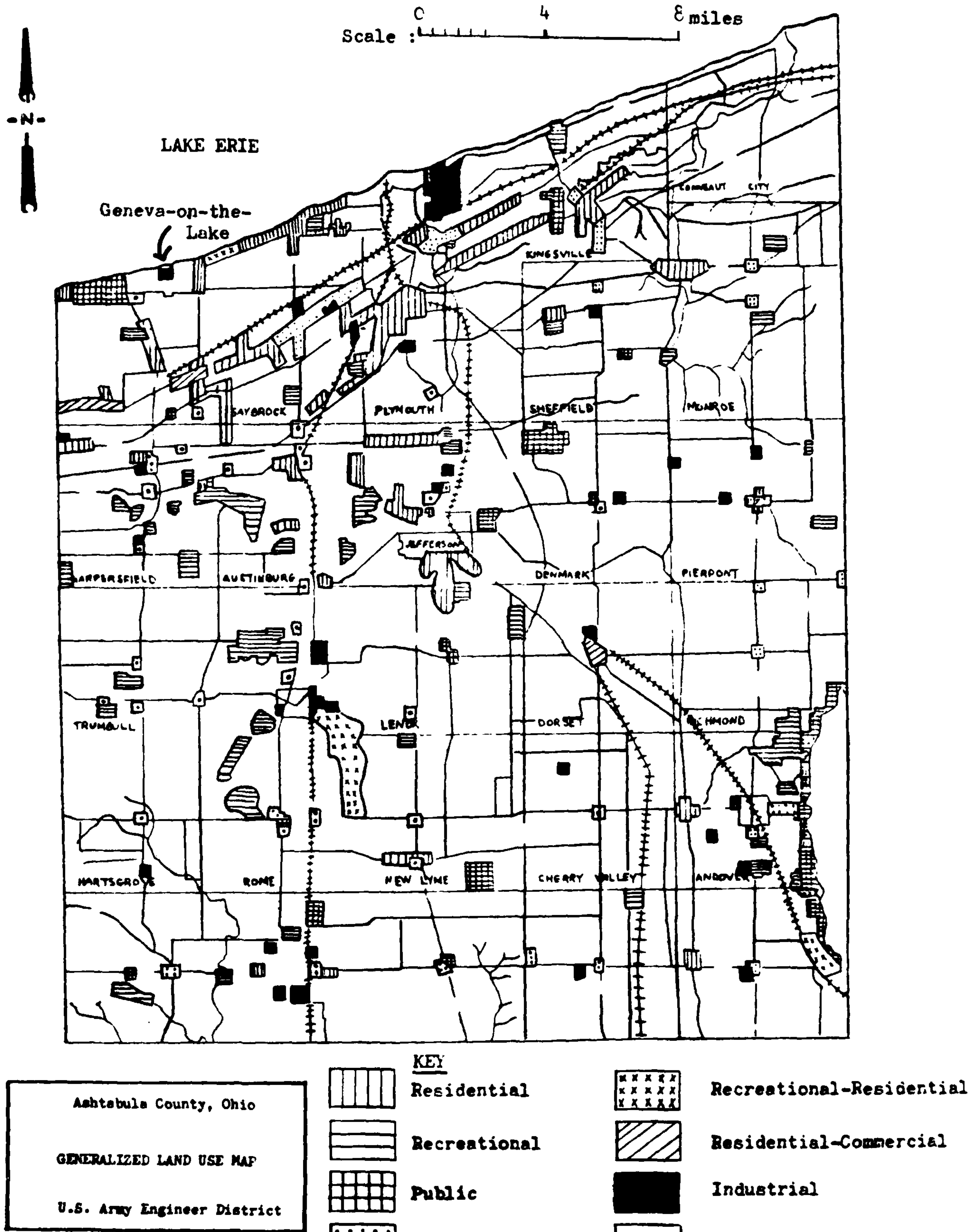
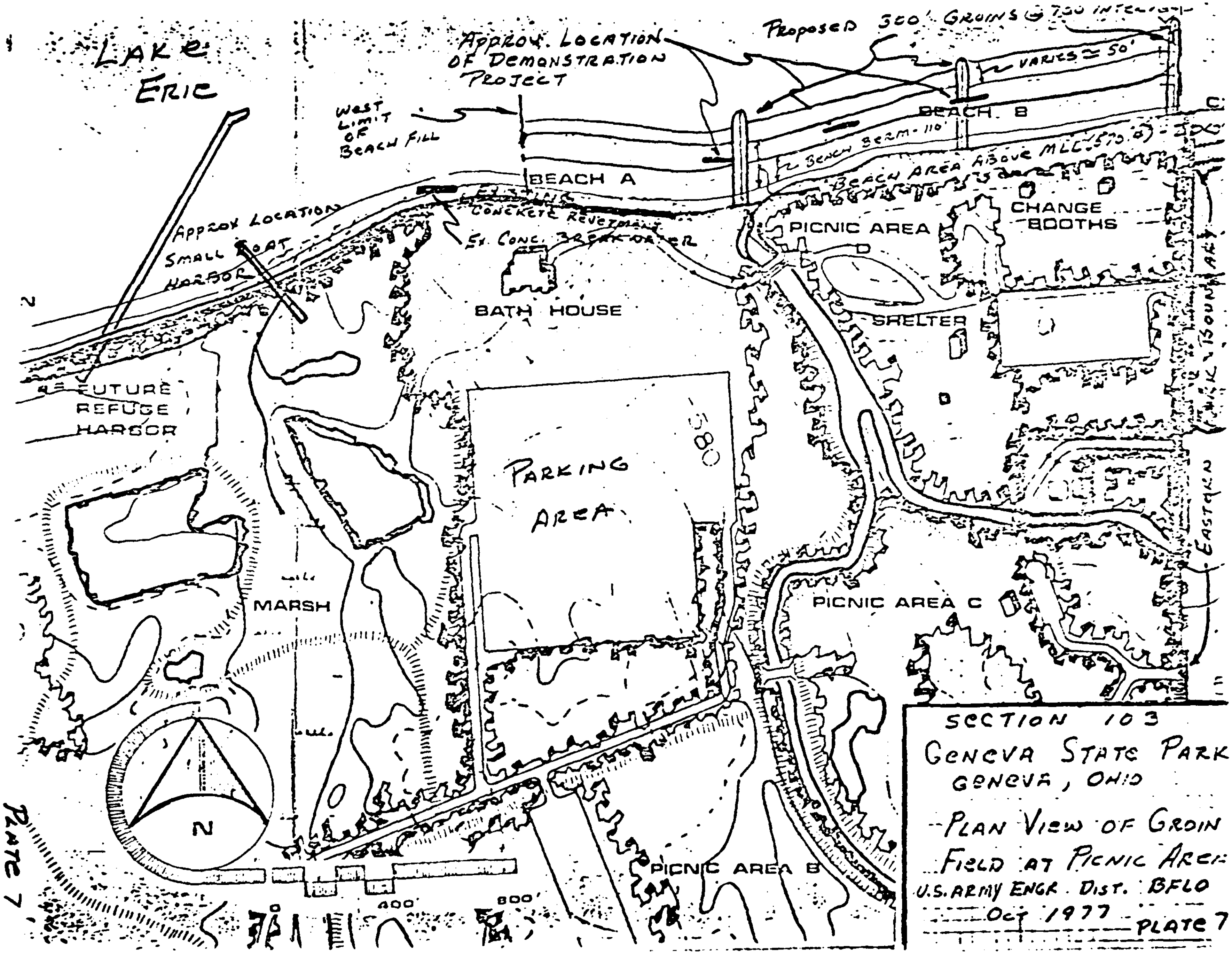

N
LAKE ERIE
BATH HOUSE
OPEN WATER
OPEN WATER
Ag
LEGEND
○ Dominant
△ Subdominant
P Pickerel Weed
Y Yellow water lily
Ct Common Cattail
SSB Soft Stem Bullrush
S Sedges
AH Arrowhead
V Vervane
rs Rushes
Ph Phragmities
I Iris
Av Arrowwood Viburnum
D Dogwood
Mr Multiflora Rose
C Cottonwood
Pi Poison Ivy
W Willow
SS Staghorn Sumac
Rc Rice Cut Grass
G Goldenrod
H Horsetail
Hy Honeysuckle
As Ash
Ag Assorted Grasses
F Forbes
B Blackberry
GENEVA-ON-THE-LAKE, OHIO
SMALL BOAT HARBOR STUDY
WETLAND VEGETATION MAP
U.S. ARMY ENGINEER DISTRICT BUFFALO

Plate 9



Scale : 0 4 8 miles
-N-
LAKE ERIE
Geneva-on-the-Lake
CONNEAUT CITY
KINGSVILLE
SAYBROOK
PLYMOUTH
SHEFFIELD
MONROE
JEFFERSON
AUSTINBURG
DENMARK
PIERPONT
TRUMBULL
DORSET
ROME
NEW LYME
CHERRY VALLEY
ANDOVER
Ashtabula County, Ohio
GENERALIZED LAND USE MAP
U.S. Army Engineer District
KEY
Residential
Recreational
Public
Commercial
Recreational-Residential
Residential-Commercial
Industrial
Agricultural-Rural


Plate 10




SECTION 103

GENEVA STATE PARK

GENEVA, OHIO

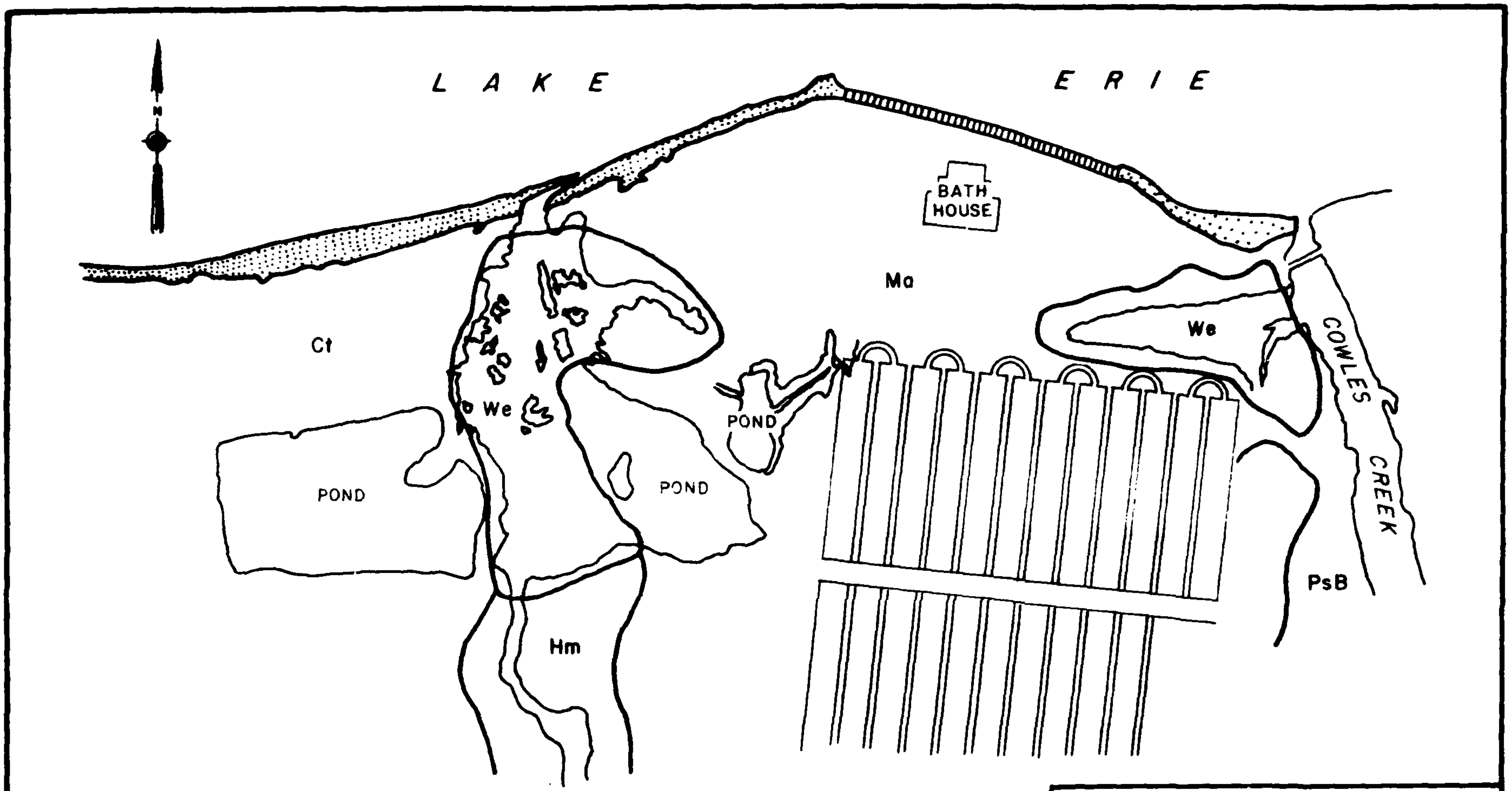
PLAN VIEW OF GROIN FIELD AT PICNIC AREA

U.S. ARMY ENGR. DIST. BFLO

OCT 1977

PLATE 7

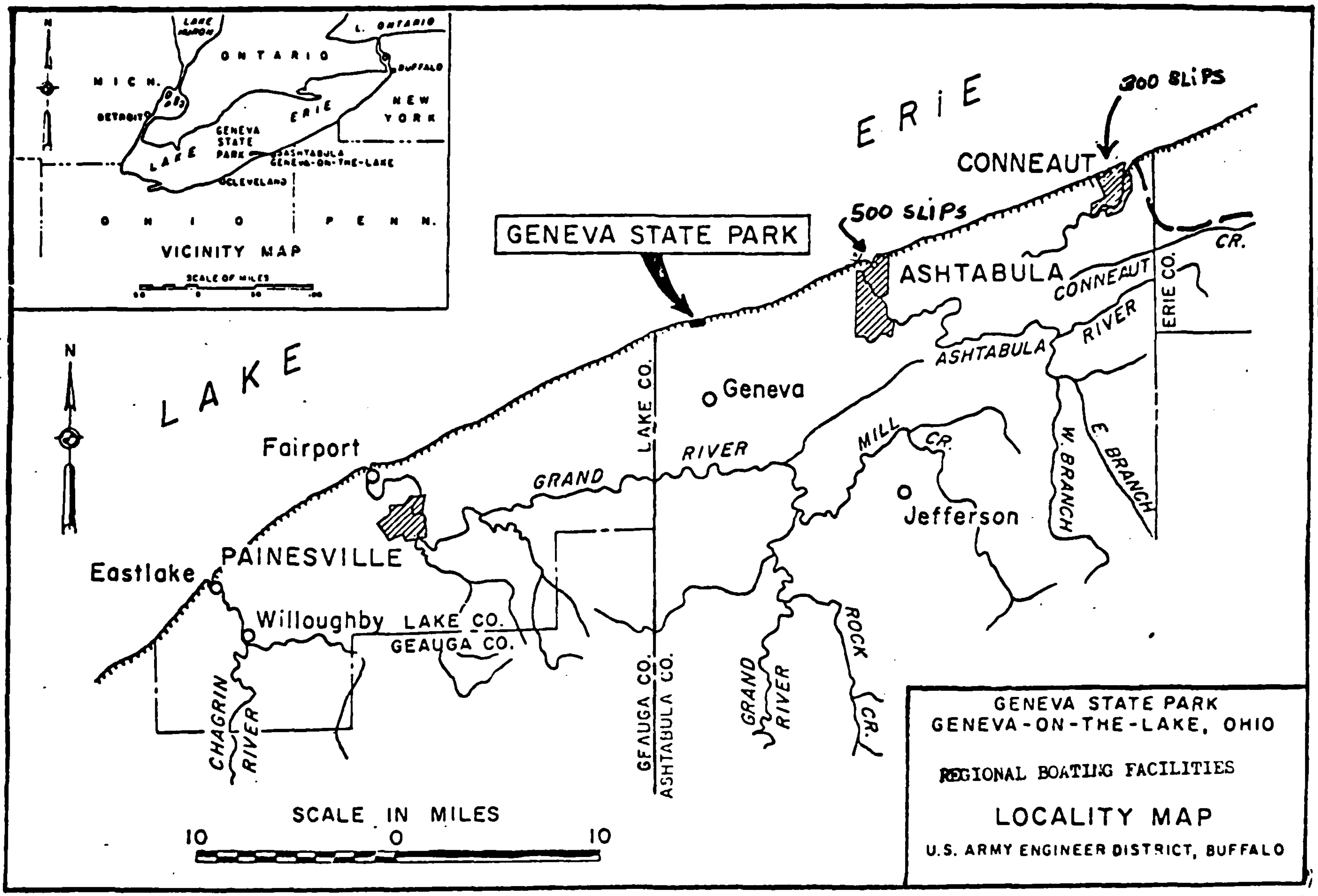
PLATE 7




GENEVA - ON - THE - LAKE, OHIO
SMALL BOAT HARBOR STUDY

SOILS MAP

U S ARMY ENGINEER DISTRICT BUFFALO



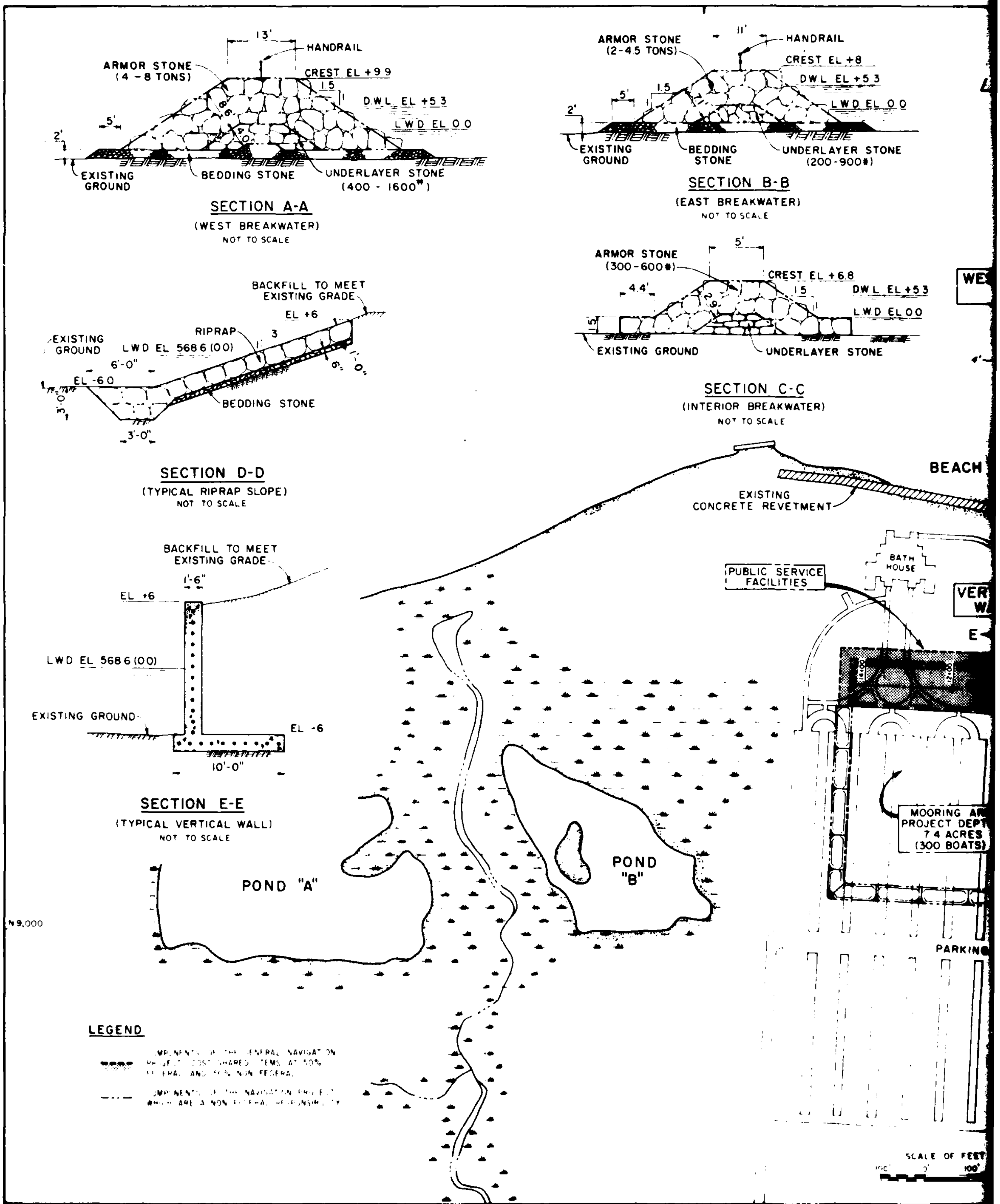
GENEVA STATE PARK
GENEVA-ON-THE-LAKE, OHIO

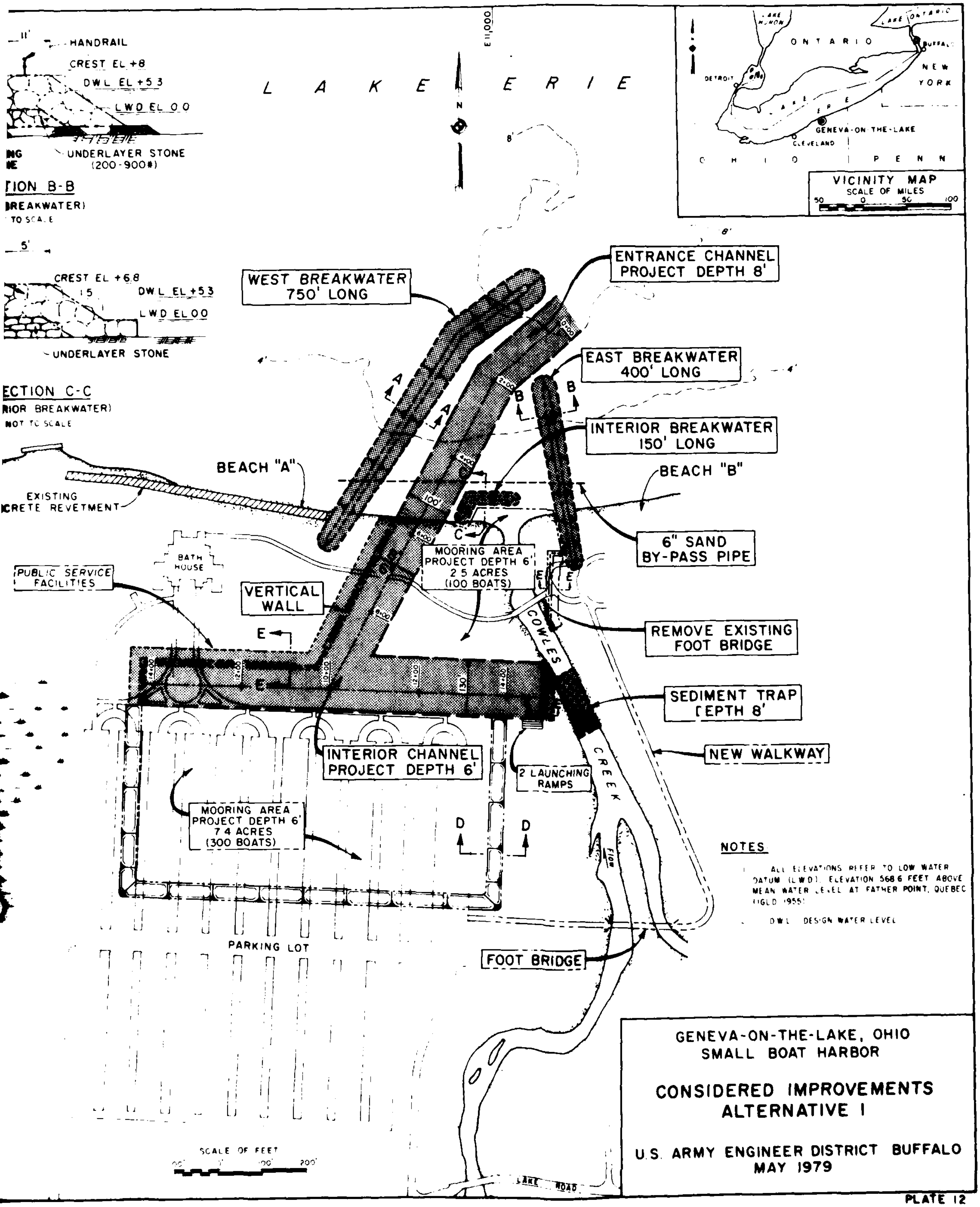
REGIONAL BOATING FACILITIES

LOCALITY MAP

U.S. ARMY ENGINEER DISTRICT, BUFFALO

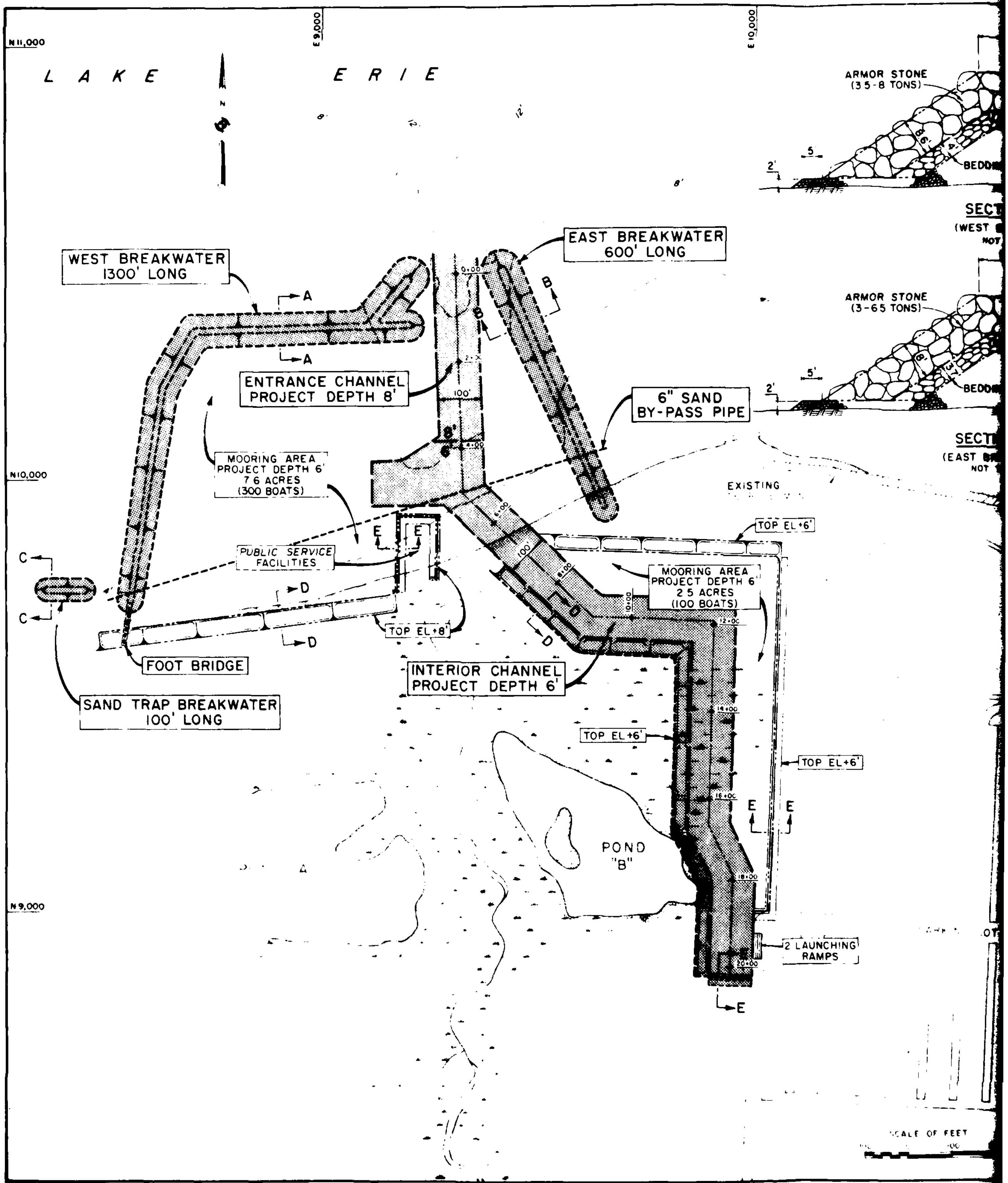
Plate 11


13'
HANDRAIL
ARMOR STONE
(4 - 8 TONS)
CREST EL +9.9
1.5
1
D.W.L. EL +5.3
L.W.D. EL 0.0
2'
5'
EXISTING
GROUND
BEDDING STONE
UNDERLAYER STONE
(400 - 1600#)
SECTION A-A
(WEST BREAKWATER)
NOT TO SCALE
ARMOR STONE
(2-4.5 TONS)
11'
HANDRAIL
CREST EL +8
D.W.L. EL +5.3
L.W.D. EL 0.0
1.5
5'
2'
EXISTING
GROUND
BEDDING
STONE
UNDERLAYER STONE
(200-900#)
SECTION B-B
(EAST BREAKWATER)
NOT TO SCALE
ARMOR STONE
(300-600#)
5'
CREST EL +6.8
4.4'
1.5
D.W.L. EL +5.3
L.W.D. EL 0.0
EXISTING GROUND
UNDERLAYER STONE
SECTION C-C
(INTERIOR BREAKWATER)
NOT TO SCALE
BACKFILL TO MEET
EXISTING GRADE
EL +6
RIPRAP
3
EXISTING
GROUND
L.W.D. EL 568.6 (0.0)
6'-0"
EL -6.0
3'-0"
6"
1'-0"
BEDDING STONE
3'-0"
SECTION D-D
(TYPICAL RIPRAP SLOPE)
NOT TO SCALE
BACKFILL TO MEET
EXISTING GRADE
1'-6"
EL +6
L.W.D. EL 568.6 (0.0)
EXISTING GROUND
EL -6
10'-0"
SECTION E-E
(TYPICAL VERTICAL WALL)
NOT TO SCALE
BEACH
EXISTING
CONCRETE REVETMENT
BATH
HOUSE
PUBLIC SERVICE
FACILITIES
POND "A"
POND "B"
N 9,000
MOORING AR
PROJECT DEPT
7.4 ACRES
(300 BOATS)
PARKING
LEGEND
SCALE OF FEET

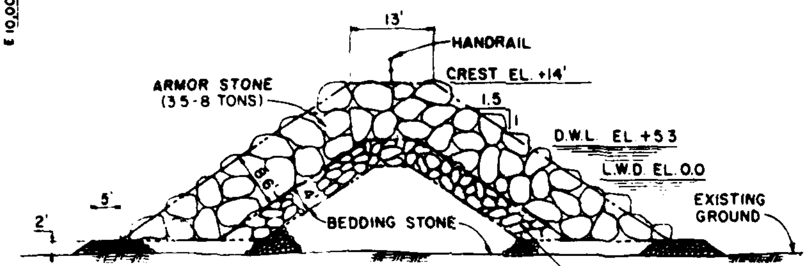


HANDRAIL
CREST EL +8
DWL EL +5.3
LWD EL 0.0
UNDERLAYER STONE
(200-900#)
TION B-B
BREAKWATER)
TO SCALE
CREST EL +6.8
DWL EL +5.3
LWD EL 0.0
UNDERLAYER STONE
ECTION C-C
RIOR BREAKWATER)
NOT TO SCALE
EXISTING
CRETE REVETMENT
L A K E E R I E
E 11,000
N
WEST BREAKWATER
750' LONG
ENTRANCE CHANNEL
PROJECT DEPTH 8'
EAST BREAKWATER
400' LONG
INTERIOR BREAKWATER
150' LONG
BEACH "A"
BEACH "B"
6" SAND
BY-PASS PIPE
MOORING AREA
PROJECT DEPTH 6'
2.5 ACRES
(100 BOATS)
BATH HOUSE
PUBLIC SERVICE
FACILITIES
VERTICAL
WALL
REMOVE EXISTING
FOOT BRIDGE
COWLES
SEDIMENT TRAP
DEPTH 8'
NEW WALKWAY
INTERIOR CHANNEL
PROJECT DEPTH 6'
2 LAUNCHING
RAMPS
CREEK
MOORING AREA
PROJECT DEPTH 6'
7.4 ACRES
(300 BOATS)
PARKING LOT
FOOT BRIDGE
FLOW
LAKE ROAD
SCALE OF FEET
NOTES
ALL ELEVATIONS REFER TO LOW WATER DATUM (LWD), ELEVATION 568.6 FEET ABOVE MEAN WATER LEVEL AT FATHER POINT, QUEBEC (IGLD 1955)
DWL DESIGN WATER LEVEL
LAKE HURON
ONTARIO
LAKE ONTARIO
BUFFALO
NEW YORK
DETROIT
LAKE ERIE
GENEVA-ON-THE-LAKE
CLEVELAND
OHIO
PENN
VICINITY MAP
SCALE OF MILES
50 0 50 100
GENEVA-ON-THE-LAKE, OHIO
SMALL BOAT HARBOR
CONSIDERED IMPROVEMENTS
ALTERNATIVE I
U.S. ARMY ENGINEER DISTRICT BUFFALO
MAY 1979


PLATE 12

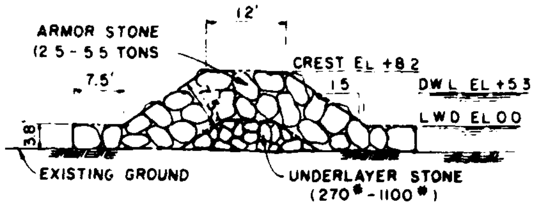


N 11,000
E 9,000
E 10,000
LAKE ERIE
N 10,000
N 9,000
ARMOR STONE (3.5-8 TONS)
BEDDING
ARMOR STONE (3-6.5 TONS)
WEST BREAKWATER 1300' LONG
EAST BREAKWATER 600' LONG
ENTRANCE CHANNEL PROJECT DEPTH 8'
6" SAND BY-PASS PIPE
MOORING AREA PROJECT DEPTH 6' 7.6 ACRES (300 BOATS)
EXISTING
TOP EL +6'
PUBLIC SERVICE FACILITIES
MOORING AREA PROJECT DEPTH 6' 2.5 ACRES (100 BOATS)
TOP EL +8'
FOOT BRIDGE
INTERIOR CHANNEL PROJECT DEPTH 6'
SAND TRAP BREAKWATER 100' LONG
TOP EL +6'
TOP EL +6'
POND "B"
2 LAUNCHING RAMPS
SCALE OF FEET



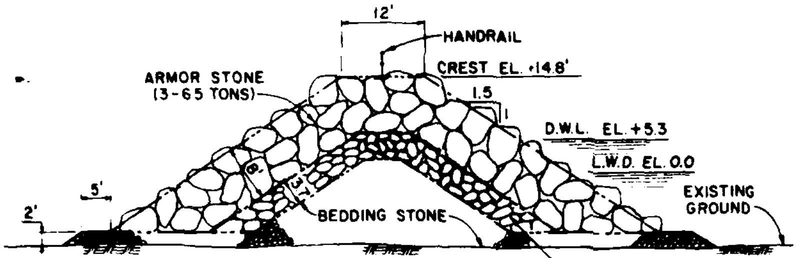

SECTION A-A

(WEST BREAKWATER)
NOT TO SCALE



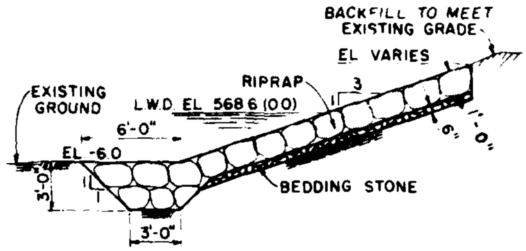

SECTION C-C

(SAND TRAP BREAKWATER)
NOT TO SCALE



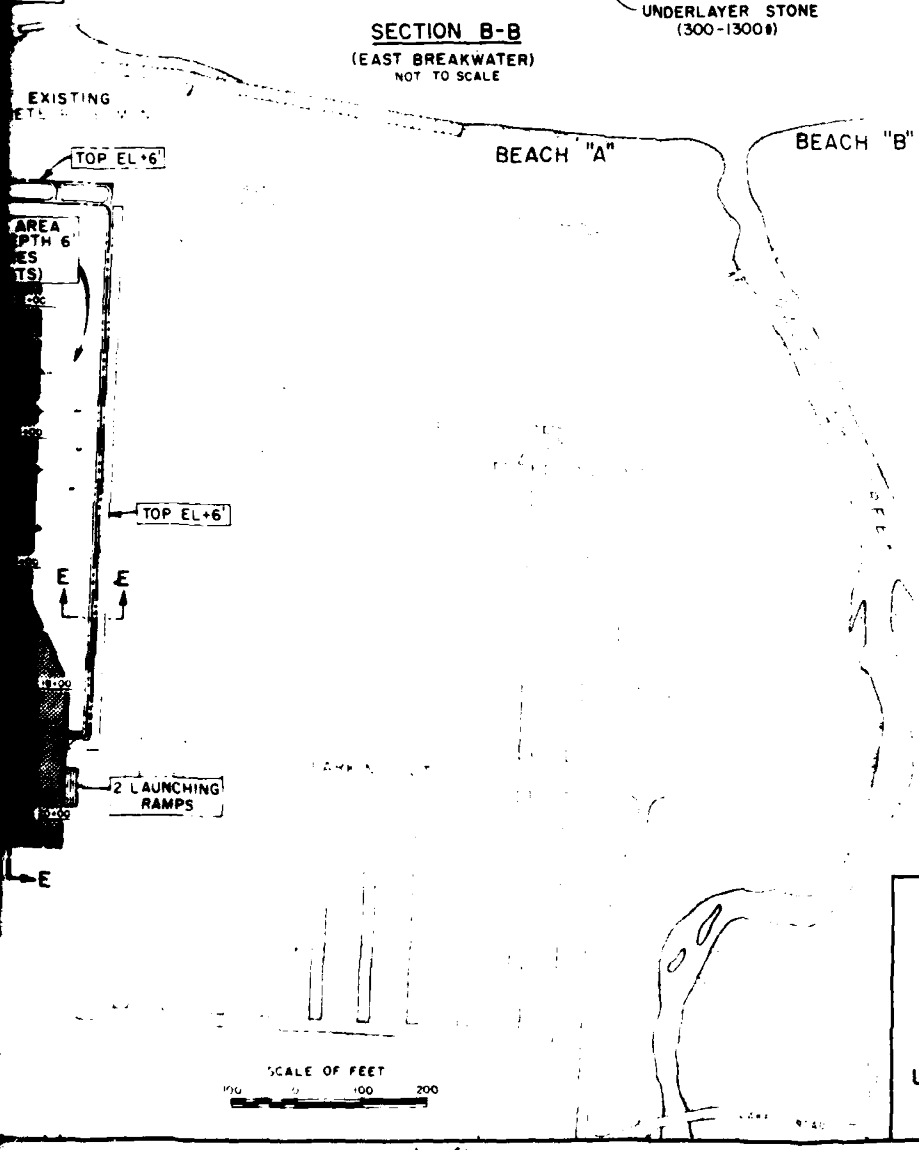

SECTION B-B

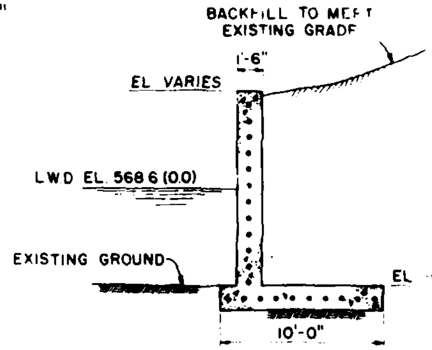
(EAST BREAKWATER)
NOT TO SCALE




SECTION D-D

(TYPICAL RIPRAP SLOPE)
NOT TO SCALE




SECTION E-E

(TYPICAL VERTICAL WALL)
NOT TO SCALE

NOTES:

ALL ELEVATIONS REFER TO LOW WATER DATUM (LWD), ELEVATION 568.6 FEET ABOVE MEAN WATER LEVEL AT FATHER POINT, QUEBEC (IGLD 1955)

DWL DESIGN WATER LEVEL

LEGEND:

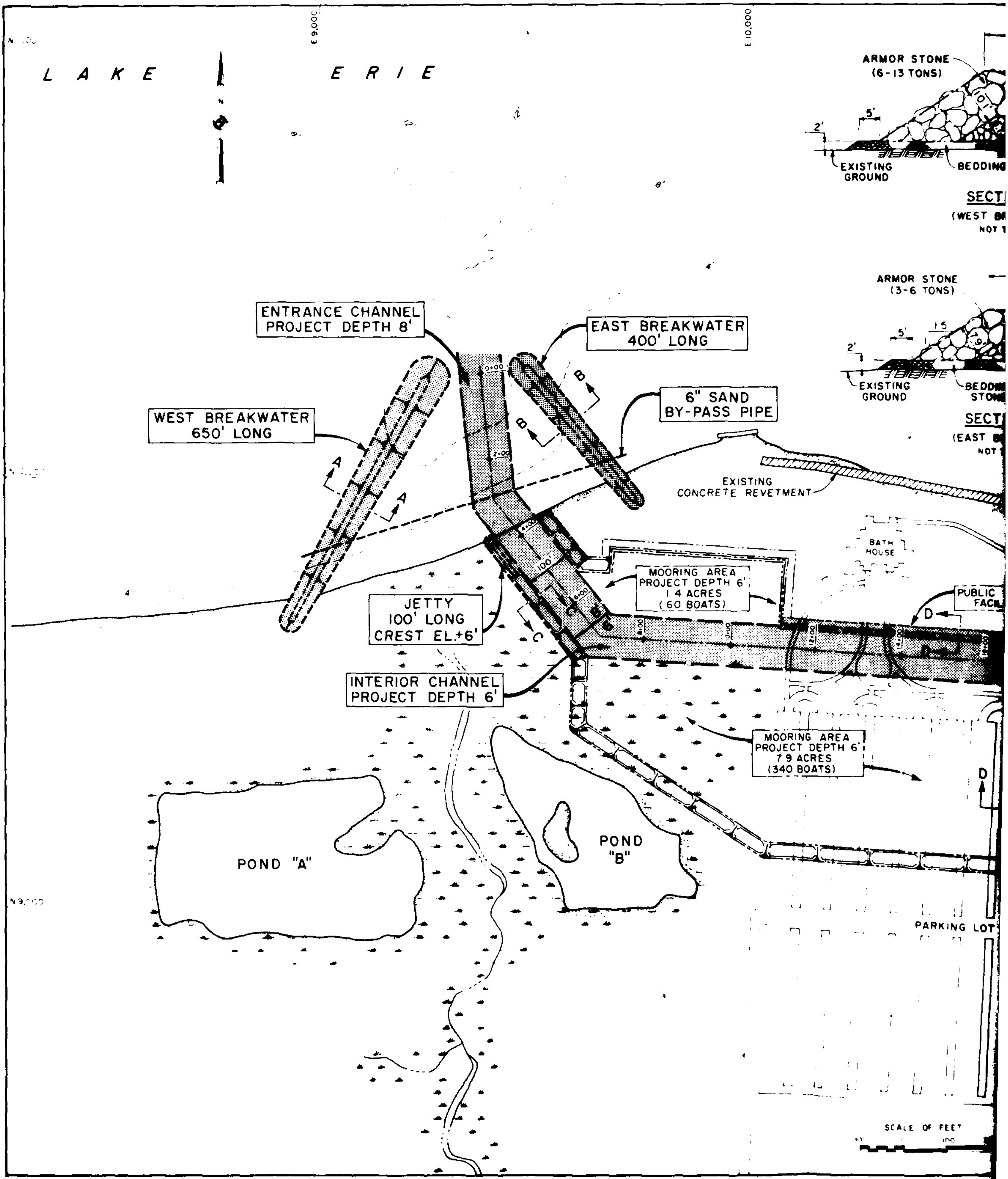
COMPONENTS OF THE GENERAL NAVIGATION PROJECT (COST SHARED ITEM) AT 50% FEDERAL AND 50% NON FEDERAL

COMPONENTS OF THE NAVIGATION PROJECT WHICH ARE A NON FEDERAL RESPONSIBILITY

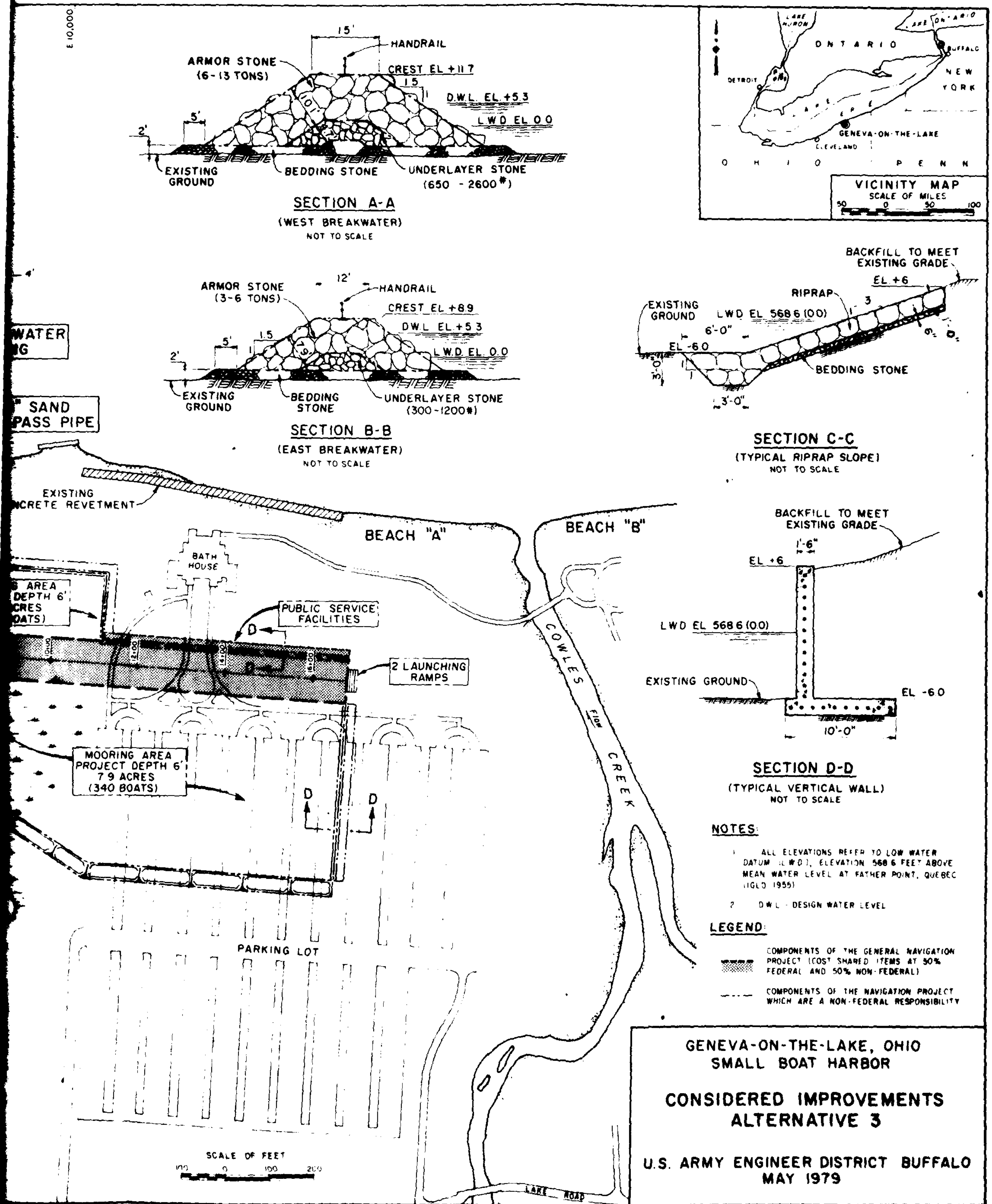
GENEVA-ON-THE-LAKE, OHIO
SMALL BOAT HARBOR

CONSIDERED IMPROVEMENTS
ALTERNATIVE 2

U.S. ARMY ENGINEER DISTRICT BUFFALO
MAY 1979

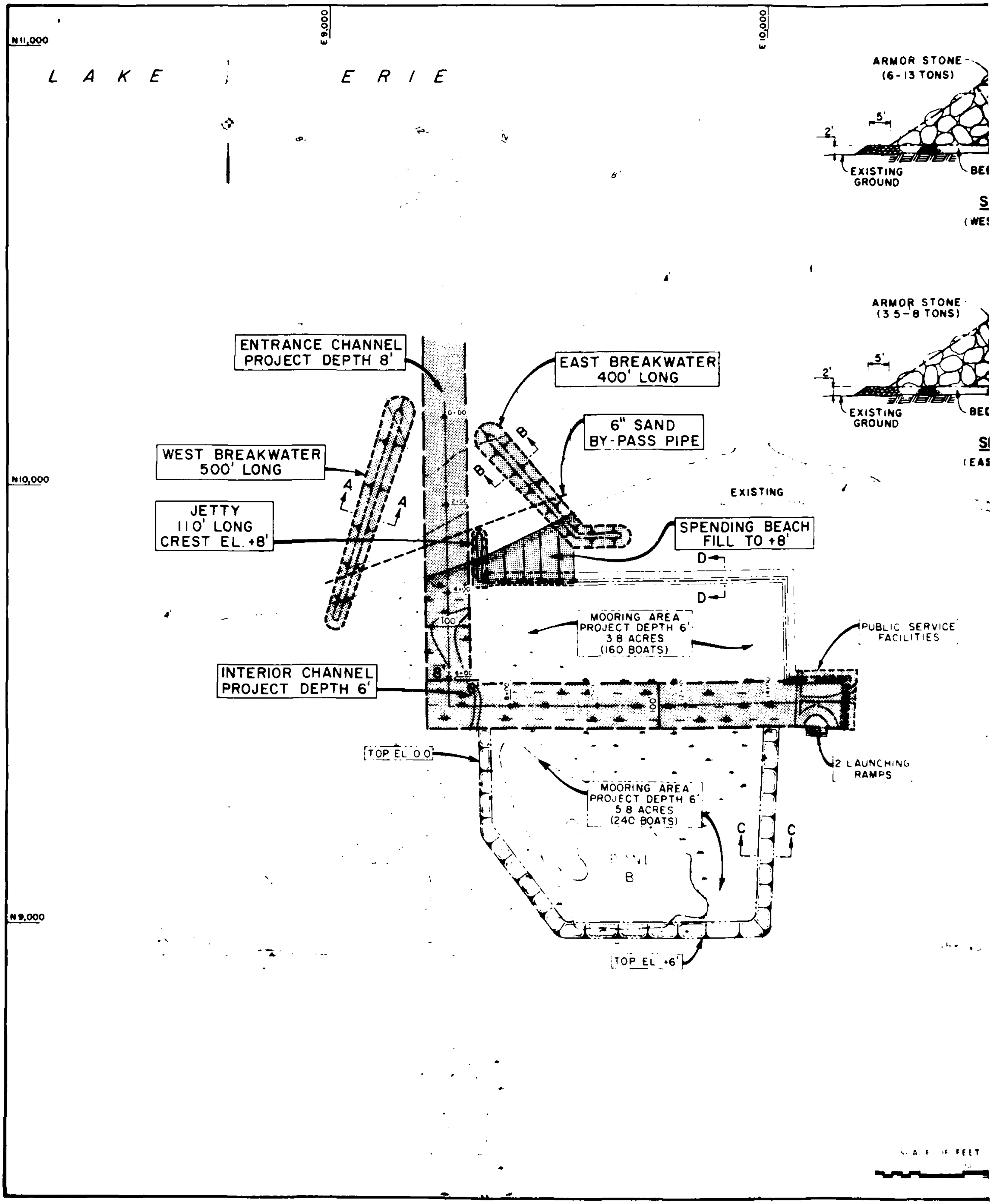


LAKE ERIE
E 9,000
E 10,000
ARMOR STONE (6-13 TONS)
5'
2'
EXISTING GROUND
BEDDING
SECT
(WEST
ARMOR STONE (3-6 TONS)
5'
1.5
2'
EXISTING GROUND
BEDDI STON
SECT
(EAST
ENTRANCE CHANNEL PROJECT DEPTH 8'
EAST BREAKWATER 400' LONG
WEST BREAKWATER 650' LONG
6" SAND BY-PASS PIPE
EXISTING CONCRETE REVETMENT
BATH HOUSE
MOORING AREA PROJECT DEPTH 6' 1.4 ACRES (60 BOATS)
JETTY 100' LONG CREST EL.+6'
INTERIOR CHANNEL PROJECT DEPTH 6'
PUBLIC FACI
MOORING AREA PROJECT DEPTH 6' 7.9 ACRES (340 BOATS)
POND "A"
POND "B"
PARKING LOT
SCALE OF FEET

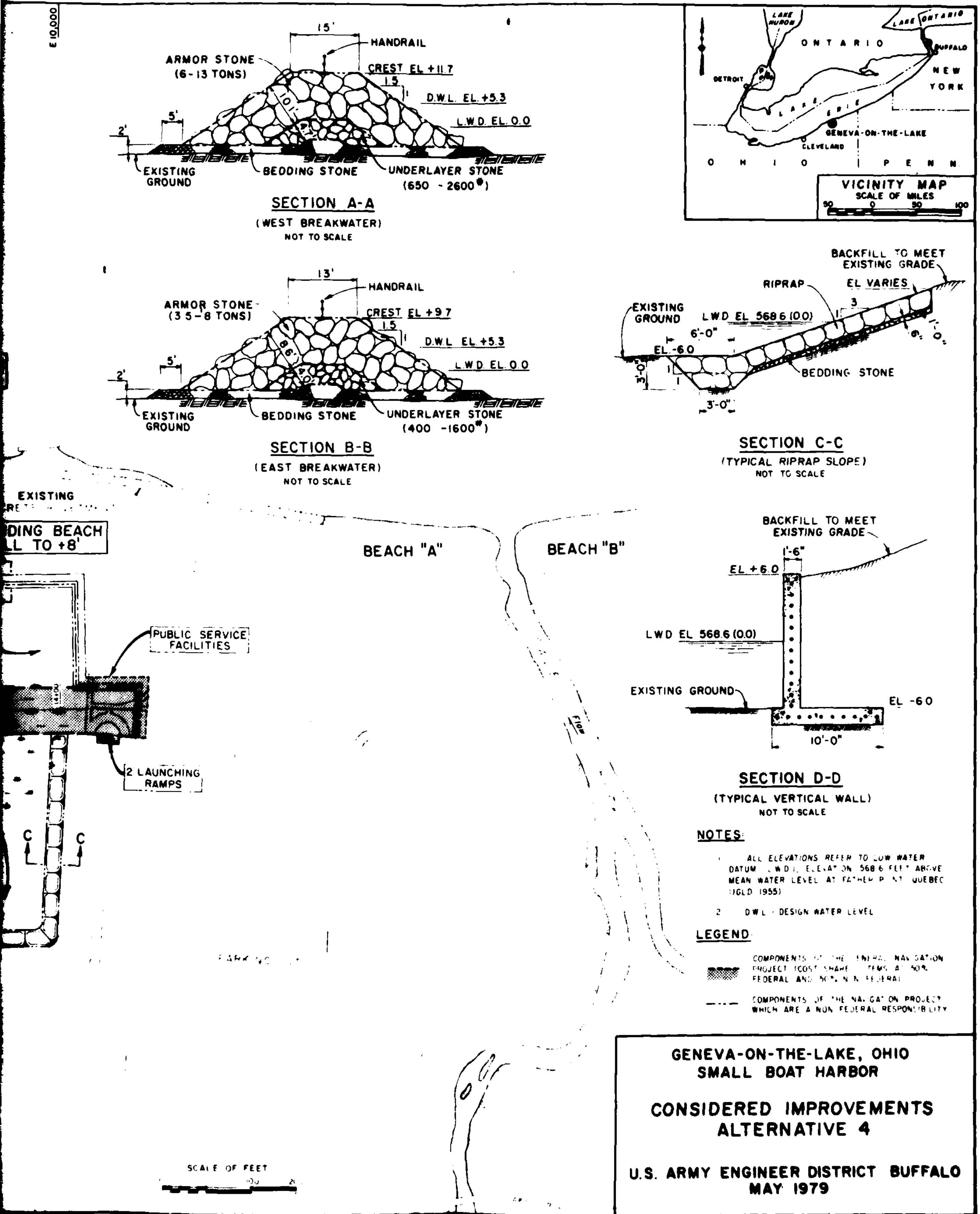


ARMOR STONE (6-13 TONS)
HANDRAIL
CREST EL +11.7
D.W.L. EL +5.3
LWD EL 0.0
EXISTING GROUND
BEDDING STONE
UNDERLAYER STONE (650 - 2600#)
SECTION A-A
(WEST BREAKWATER)
NOT TO SCALE
ARMOR STONE (3-6 TONS)
HANDRAIL
CREST EL +8.9
DWL EL +5.3
LWD EL 0.0
EXISTING GROUND
BEDDING STONE
UNDERLAYER STONE (300-1200#)
SECTION B-B
(EAST BREAKWATER)
NOT TO SCALE
LAKE HURON
ONTARIO
LAKE ONTARIO
BUFFALO
NEW YORK
DETROIT
LAKE ERIE
GENEVA-ON-THE-LAKE
CLEVELAND
OHIO
PENN
VICINITY MAP
SCALE OF MILES
BACKFILL TO MEET EXISTING GRADE
EL +6
RIPRAP
LWD EL 568.6 (0.0)
EXISTING GROUND
EL -6.0
BEDDING STONE
SECTION C-C
(TYPICAL RIPRAP SLOPE)
NOT TO SCALE
SAND PASS PIPE
EXISTING CONCRETE REVETMENT
BEACH "A"
BEACH "B"
BATH HOUSE
PUBLIC SERVICE FACILITIES
2 LAUNCHING RAMPS
MOORING AREA PROJECT DEPTH 6' 7.9 ACRES (340 BOATS)
COWLES CREEK
FLOW
PARKING LOT
SCALE OF FEET
LAKE ROAD
BACKFILL TO MEET EXISTING GRADE
EL +6
LWD EL 568.6 (0.0)
EXISTING GROUND
EL -6.0
10'-0"
SECTION D-D
(TYPICAL VERTICAL WALL)
NOT TO SCALE
NOTES:
1. ALL ELEVATIONS REFER TO LOW WATER DATUM (L.W.D.), ELEVATION 568.6 FEET ABOVE MEAN WATER LEVEL AT FATHER POINT, QUEBEC (IGLD 1955)
2. DWL - DESIGN WATER LEVEL
LEGEND:
COMPONENTS OF THE GENERAL NAVIGATION PROJECT (COST SHARED ITEMS AT 50% FEDERAL AND 50% NON-FEDERAL)
COMPONENTS OF THE NAVIGATION PROJECT WHICH ARE A NON-FEDERAL RESPONSIBILITY
GENEVA-ON-THE-LAKE, OHIO
SMALL BOAT HARBOR
CONSIDERED IMPROVEMENTS
ALTERNATIVE 3
U.S. ARMY ENGINEER DISTRICT BUFFALO
MAY 1979


PLATE 14



N11,000
E 9,000
E 10,000
LAKE ERIE
ARMOR STONE (6-13 TONS)
5'
2'
EXISTING GROUND
ARMOR STONE (3.5-8 TONS)
5'
2'
EXISTING GROUND
ENTRANCE CHANNEL PROJECT DEPTH 8'
EAST BREAKWATER 400' LONG
6" SAND BY-PASS PIPE
WEST BREAKWATER 500' LONG
N10,000
JETTY 110' LONG CREST EL. +8'
EXISTING
SPENDING BEACH FILL TO +8'
MOORING AREA PROJECT DEPTH 6' 3.8 ACRES (160 BOATS)
PUBLIC SERVICE FACILITIES
INTERIOR CHANNEL PROJECT DEPTH 6'
TOP EL 0.0
2 LAUNCHING RAMPS
MOORING AREA PROJECT DEPTH 6' 5.8 ACRES (240 BOATS)
N9,000
TOP EL +6'




NOTES:

1. ALL ELEVATIONS REFER TO LOW WATER DATUM (LWD), ELEVATION 568.6 FEET ABOVE MEAN WATER LEVEL AT FATHER P[illegible]NT, QUEBEC (IGLD 1955)
2. DWL - DESIGN WATER LEVEL

LEGEND:

COMPONENTS OF THE [illegible] NAVIGATION PROJECT (COST SHARE[illegible] [illegible]TEMS AT 50% FEDERAL AND 50% N[illegible]N FEDERAL

COMPONENTS OF THE NAVIGATION PROJECT WHICH ARE A NON FEDERAL RESPONSIBILITY

GENEVA-ON-THE-LAKE, OHIO
SMALL BOAT HARBOR

CONSIDERED IMPROVEMENTS
ALTERNATIVE 4

U.S. ARMY ENGINEER DISTRICT BUFFALO
MAY 1979

PLATE 15

2

DATE
ILMED
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